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THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE
INSTITUTION OF BRITISH FOUNDRYMEN AND THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION.

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Heat-Treating Cast-iron.

The British foundry world has recently had submitted to it much information relative to the strength of cast iron at elevated temperatures, the practical bearing being, of course, the behaviour of engine cylinders and pistons. Of equal importance is the question of the strength of cold cast iron after treatment, and any details of this should be welcomed by foundry-men. Such an investigation has recently been carried out by M. Jean Durand, and his conclusions have recently been presented to the French Académie des Sciences. In the course of his remarks Mons. Durand stated that thermal treatment, whilst being in general use for steel, is practically unknown for cast iron. Theories relating to the constitution of cast iron have been put forward by both Charpy and Hatfield, and they present a sufficiently substantial base on which to continue research, for on the whole they were confirmed by this investigator. According to these hypotheses, cast iron can be looked upon as being made up from the structural point of view as a mixture of steel and graphite. Thus, the mechanical characteristics of cast iron will be simultaneously affected by the physico-chemical condition of the steel, and the state of division and distribution of the graphite existing as an inclusion and tending to lower the tensile strength of the mass.

The tests were carried out on numerous samples taken from four irons having the following composition:—

Mark.	Gr. C.	Ce.	Si.	Mn.	S.	P.
A. ...	2.72	0.48	1.18	0.53	0.048	0.21
B. ...	2.50	0.75	1.08	0.43	0.056	0.13
C. ...	2.40	0.56	0.82	0.84	0.048	0.15
D. ...	2.74	0.32	1.19	0.50	0.041	0.25

These tests were carried out according to the specifications issued by the French railway companies. Drop tests were made with a 12 kg (26 lbs.) weight falling initially from a height of 35 cm. (15¾ ins.), increasing this by 5 cms. (2 ins.), until fracture takes place.

For the first experiment samples were heated to 900 deg. C. for 45 minutes, and normally cooled in an electrically-heated muffle furnace, after which they gave the following tests:—

Mark.	Max. stress in tons per sq. in.		Mean breaking height in inches.		Total work necessary for breaking in ft. lbs.	
	Before.	After.	Before.	After.	Before.	After.
A. ...	14.6	10.2	25.3	23.4	8.5	6.8
B. ...	16.1	9.9	21.4	23.4	5.4	6.8
C. ...	13.0	10.3	21.4	19.5	5.4	4.1
D. ...	14.6	9.9	25.3	23.4	8.5	6.8

Generally speaking, the tensile is considerably reduced by the heat-treatment. This is readily explained by the change of a part of the combined to graphitic carbon at 900 deg. C., at which temperature the iron-carbon system has a stable form in which the carbon separates out to the graphitic condition and not to cementite. This supposition was confirmed by analysis, which showed that the increase of graphite ranged between 0.12 and 0.50 per cent.

Obviously, grey iron castings should never receive a treatment at such a temperature, and for such a time, that the separation of graphite can take place. The critical temperature is lowered as the silicon content is raised.

From further experiments, it was shown that possibly the best treatment to follow in order to increase the tensile strength is to quench in oil at 900 deg. C., and then to temper at about 650 deg. C. This treatment gave the following results:—

Mark.	Maximum stress in tons per sq. in.		Mean breaking Height in inches.	
	Before.	After.	Before.	After.
A. ...	14.6 ...	19.4 ...	25.3 ...	43.0
B. ...	16.1 ...	19.2 ...	21.4 ...	31.2
C. ...	13.0 ...	16.8 ...	21.4 ...	37.0
D. ...	14.6 ...	17.3 ...	25.3 ...	31.2

The increase shown was lowest in iron D, because it has the lower carbon content and is thus least susceptible to quenching and reheating.

Mons. Durand's results are of the greatest practical value, especially if they could be confirmed by ordinary foundry practice. It would be interesting if an electric cast-iron, which untreated often gives 20 tons per sq. in., could be heat-treated according to the conditions laid down by the author.

The International Foundry Exhibition.

Opening Ceremony

The exhibition was opened last Thursday afternoon by the Lord Mayor (Alderman David Davis), who was accompanied by the Lady Mayoress. The ceremony was presided over by Mr. F. L. Hickinbotham (president of Birmingham Chamber of Commerce), and there were also on the platform Sir William Ashley, Mr. H. L. Reason (president-elect of the Institution of British Foundrymen), Mr. C. Lakin-Smith, and Mr. G. H. Wright (secretary of the Chamber of Commerce).

THE CHAIRMAN, in introducing the Lord Mayor, remarked that his lordship was always willing and anxious to assist not only social and charitable movements, but also anything calculated to promote the interests of commerce. As for the exhibition, it was certainly the most comprehensive ever held in England, and was on a larger scale than any undertaking promoted so far by the American industry. Approximately 1,000 tons of machinery had been installed, and between 300 and 400 horse-power engines were necessary to supply the energy for the working exhibits. Despite the engineering lockout the firms participating had overcome exceptional difficulties, and the result of their efforts was an unparalleled display of everything appertaining to the foundry trade. The exhibition coincided with the annual conference of the Institution of British Foundrymen, and with meetings of the Institute of Metals and the Institute of Automobile Engineers, which were also being held in Birmingham. A number of interesting competitions in moulding and pattern-making had been arranged, and the promoters had the pleasure of welcoming—which was quite an innovation—exhibitors from the United States of America, France, and Belgium.

MR. H. L. REASON, who was called upon for a few remarks, said he desired to emphasise the fact that the Institution of British Foundrymen attached great value to the exhibition. From the short survey he had been able to make he was sure it would come to be regarded as an epoch-making event in connection with the foundry trades. As had been mentioned, it was the first of its kind ever held in Europe, which was rather a sad admission to be obliged to make, inasmuch as the iron foundry was the birthplace of everything appertaining to the engineering trades. Quite a large number of members of the Institution were attending the Convention during the following week. These conventions were always of an instructive nature from the point of view of the papers read and discussed, but he felt sure that the exhibition would prove a considerable help to this year's gathering, and do much to encourage the study of ironfounding and promote its progress.

THE LORD MAYOR, in declaring the exhibition open, remarked that it was the second time within a few days that he had been privileged to visit Bingley Hall to perform opening ceremonies. Nothing was more remarkable, and certainly nothing was more welcome, than the activity which had been shown recently in the interests of trade and commerce by the Birmingham Chamber of Commerce. Since he had been in office he had been called upon to open the British Industries Fair, the Business Efficiency Exhibition, and he was now present to declare open a third venture promoted by the Chamber in the shape of an International Foundry Trades' Exhibition, the first of its kind ever held in this country. He ventured to think that the trade and commerce not only of Birmingham and the Midlands, but of the whole kingdom, was greatly indebted to the Chamber and to the men who directed its affairs, for the efforts they had put forth. Such an important event as the annual conference of the Institution of British Foundrymen had been seized upon by the Chamber for the purpose of holding the present exhibition, as it was considered a fitting opportunity to get together all the various kinds of machinery connected with the foundry trade. The object of the exhibition was to present a comprehensive display of up-to-date plant and equipment connected with one of the really vital industries of the country. It was a somewhat happy circumstance that the Institution of British Foundrymen and the British Cast-iron Research Association were associated in the venture on the technical side, because in these days of frequent changes and scientific progress it was of supreme importance that the foundrymen of this country should fit themselves to hold their own against their well-equipped and enterprising foreign competitors. He thought visitors to the exhibition would find it to be one of the most comprehensive that had ever been called into existence, and that it comprised an unparalleled display of everything appertaining to the foundry trade. In addition to the exhibition there were many interesting competitions, and lectures dealing with the various branches of the trade would be delivered. The object in view was to instruct and entertain; to instruct those engaged in the trade in the various up-to-date methods discovered in recent years, and to entertain those who took an ephemeral but none the less an important interest in the trade and commerce of the country. He expressed a hope that the efforts which had been put forward would prove successful, and that a similar exhibition would be held in Birmingham on a future occasion. It was international in its character, and by means of the conferences which were to take place all would learn one from the other, and the result would be, he hoped, the furtherance of common interests, so that competition might be fair and on a reasonable basis. As a proof that our own manufacturers were willing and able to face competition the importance of exhibitions like this could not be exaggerated. If the Birmingham Chamber of Commerce continued the activities which had marked its existence during the past two or three years, he felt sure that the trade of the district would soon be brought back to a pre-war level, to the benefit of all. This was a period when all should put forth their strength, because, for reasons none could help, the commerce of the country had fallen to a depth from which it was difficult to extricate it.

THE CHAIRMAN asked permission to mention at this point the splendid way in which Mr. Charles Stanley had grappled with enormous difficulties in order to make the exhibition what it was. If it had not been for Mr. Stanley's willing and efficient work the exhibition could not have taken place.

MR. LAKIN-SMITH, in proposing a hearty vote of thanks to the Lord Mayor and Lady Mayoress, remarked that the Lord Mayor spent most of his time in doing good work for the citizens, but he had probably never been better employed than in opening this present exhibition, from which so much was hoped for in the shape of a revival of trade. When the exhibition was first mooted there were those who thought that in view of the trade slump it should not be held at present, but the Chamber of Commerce and the other associations concerned felt very strongly that because there was bad trade the exhibition was all the more needed. The old Japanese proverb, "It is the melancholy fact that gets stung by the bee," aptly illustrated the feelings of the promoters. They recognised that in order to get future success they must grip firmly to-day, for to-day was the parent of to-morrow.

The vote was seconded by MR. PERRIS, and carried amid applause.

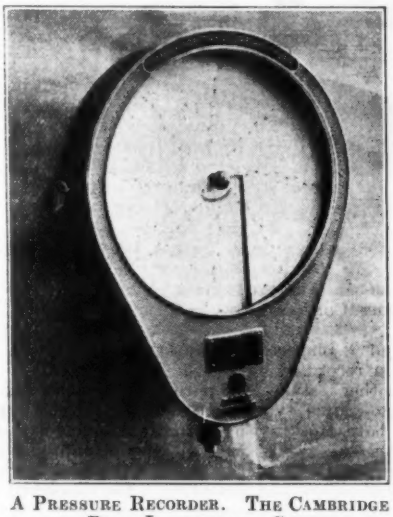
THE LORD MAYOR, in reply, said it was a pleasure to open the exhibition because he was filled with hope that it might be successful in reviving to some degree the trade of the district. He supposed that he would never be stung by the bee referred to by Mr. Lakin-Smith, because he was of a peculiarly optimistic nature.

Further Exhibits.

THE CAMBRIDGE AND PAUL INSTRUMENT COMPANY, LIMITED.

This firm are showing a collection of their instruments as applied to the foundry trades including electrical CO_2 instruments, electrical distance thermometers, draught and pressure gauges, resistance thermometers, thermo-electric pyrometers, radiation and optical pyrometers and a selection of mercury-in-glass thermometers and also a new temperature regulator.

Electrical CO_2 Instruments.—These are electrical in operation, require no chemical absorbent, have no delicate glass work, and are very accurate and sensitive. The CO_2 meter itself contains two identical spirals of platinum wire, enclosed in separate cells in a metal block, one cell containing air saturated with water vapour, and the other being open to the flue gases. The platinum spirals form two arms of a Wheatstone Bridge circuit. When the current flows in this circuit, the spirals become heated and lose heat to the walls of the cells, their temperatures, and consequently, their resistances, depending on the thermal conductivities of the gases surrounding them. Changes in the percentage of carbon dioxide in the flue gases surrounding the one spiral, cause changes in the conductivity of the gas, and a consequent change in the galvanometer deflection. The Indicating or Recording Galvanometer which is connected to the CO_2 meter can therefore be calibrated to give direct readings in percentage



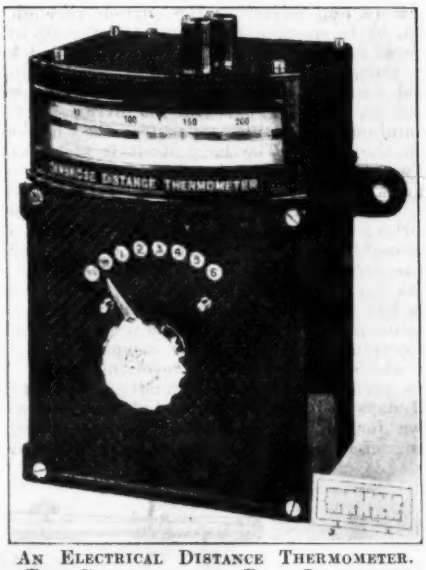
A PRESSURE RECORDER. THE CAMBRIDGE AND PAUL INSTRUMENT COMPANY.

of carbon dioxide. The exhibit also includes indicating, recording, and combined indicating and recording outfits for one or more points, and also a new portable CO_2 and temperature outfit, which will be found extremely useful for occasional tests.

Electrical Distance Thermometers.—These thermometers enable all the temperatures throughout the plant to be accurately observed or recorded on a single instrument which can be placed in the most convenient position irrespective of the distance between the thermometer and the indicator or recorder.

Indicating, Recording and Combined Indicating and Recording Outfits are shown. Both the indicators and recorders are particularly suitable for rough usage, the indicators being enclosed in a cast-iron case, which is both moisture and fume proof. These thermometers may be used for any range between 200 and 540 deg. C. These electrical distance thermometers are a type of platinum resistance thermometer in which out-of-balance current in a Wheatstone Bridge circuit is allowed to deflect a galvanometer. With the Resistance Thermometers, a portable outfit, consisting of a Whipple Indicator and a laboratory pattern resistance thermometer is also shown. The instrument is entirely self-contained, and since the galvanometer has a pivoted coil, levelling is unnecessary.

A Thermo-Electric Pyrometer Outfit is also shown with a totally enclosed indicator in a moisture and fume proof cast-iron case. The principle upon which the thermo-electric pyrometer depends is as follows—two dissimilar metals are joined at their ends to form an electric circuit, and one junction is heated and an electro-



AN ELECTRICAL DISTANCE THERMOMETER. THE CAMBRIDGE AND PAUL INSTRUMENT COMPANY.

motive force is set up which gives rise to an electric current in the circuit. The magnitude of the electro-motive force depends upon the temperatures of the hot and cold junctions. It is consequently possible, by introducing in the circuit a galvanometer, by means of which the electro-motive force generated can be measured, to determine the temperature of the hot junction, provided the cold junction temperature and the relation between temperature and electro-motive force of the two metals are known. Such a circuit can thus be used for the measurement of temperature, and a thermo-electric pyrometer consisting of a thermo-electric circuit, in which

INSTRUMENT SUITABLE FOR CONTROLLING THE TEMPERATURE OF CORE OVENS AND MOULD-DRYING STOVES. THE CAMBRIDGE AND PAUL INSTRUMENT COMPANY.

the hot junction is exposed to the temperature to be measured, and the resulting electro-motive force is measured on an indicating or recording millivoltmeter, which is, for convenience, graduated to read directly in degrees of temperature. For higher temperatures than those that can be measured by the above instruments, optical and radiation pyrometers are made use of.

Optical Pyrometers.—These are of the disappearing filament type. This is a convenient and very portable instrument for the measurement of high temperatures. The pyrometer consists of a small electric lamp, and temperatures are measured by looking through the eyepiece on the hot body and adjusting the current through the lamp, by means of a rheostat, until the tip of the filament is of the same brightness as the hot body. The temperatures are read on a small moving coiled ammeter, calibrated in temperature which forms an integral part of the pyrometer. An aluminium diaphragm separates the movement from the lamp. The lamp itself is stabilised by ageing at a high temperature before use. The battery forms a separate unit. The instrument can be adapted for two ranges by the use of absorbing glasses.

Draught and Pressure Gauges.—These instruments are designed for recording pressures and vacua up to 500 lbs. per sq. in. The pressure recorders have circular charts 9½ in. dia., the pressure to be measured acts on a Bourdon spiral, the movements of which are communicated to a pen which moves over the revolving chart. This gives permanent records extending over 24 hrs. or 7 days as required. The dial gauges are also shown for indicating draught or pressure up to 6 in. of water. A comprehensive selection of mercury-in-steel, mercury-in-glass and dial thermometers are also exhibited. The mercury-in-steel thermometers are suitable for ranges up to 540 deg. C., and are particularly suitable for gauging the temperature of feed water, superheated steam, flue gases and core ovens. The principle upon which the working of this instrument is based is as follows:—

A steel bulb is connected by means of steel capillary tubing to a special form of Bourdon spiral, the whole system being fitted with mercury. Any changes in the temperature of the bulb give rise to corresponding changes of pressure in the systems which are magnified, and are communicated to a simple pen or pointer in connection with the Bourdon spiral. The bulb may be placed as far distant as 75 ft. from the indicator. Any thermograph or Index thermometer may be fitted with an electric alarm attachment by means of which a bell is rung immediately the temperature exceeds or falls below the predetermined value; or if desired, a double attachment may be fitted, arranged for giving warnings of both maximum and minimum temperatures.

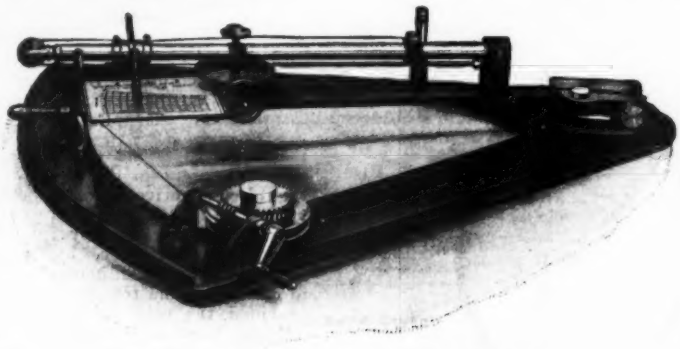
A number of Mercury-in-Glass Thermometers are also shown.

Relay for Automatic Temperature Control.—This instrument is designed on Apthorpe's patent and consists of a millivoltmeter calibrated in degrees of temperature for use with a thermo-couple. Near the extreme end of the pointer of the millivoltmeter is attached a light thermo-couple which is electrically connected to a moving-coil relay. A small platinum spiral which is heated electrically can be placed at any desired position on the scale in front of the galvanometer, but in such a way that it does not prevent the free movement of the pointer. To control the temperature of a furnace, a thermo-couple is placed in it and is connected to the millivoltmeter. The heated spiral is set at the required temperature by means of the scale. When the furnace reaches this temperature the thermo-couple founted on the pointer is brought opposite to the heater and becomes heated, thus generating a small current which operates a relay. This relay in turn closes an electrical circuit which operates a valve controlling the gas supply of the furnace. The possibilities of this form of regulator are many. It can be made to control temperatures from the lowest that can be measured by a resistance thermometer to the highest by means of a Fery pyrometer. It can also be used to operate alarms or other mechanisms. It is shown controlling the temperature of an electric furnace kindly loaned by Messrs. The Leeds Electrical Construction Co., Ltd.

Other instruments exhibited include, Depth Recorder Gauge for water level, the Rosenhain Calorimeter, the Microscope and Lathe Attachment, a Workshop Potentiometer, and various other electrical testing instruments.

FOSTER INSTRUMENT COMPANY, Letchworth.

The chief exhibit of this firm is the fixed focus radiation pyrometer, designed for working entirely at a distance. It is particularly suitable for high temperature work. This instrument is shown in alternative forms of simple portable outfit and "Inspector's" outfit; and may be used also in recording form.



HUMFREY AUTOMATIC NOTCHED-BAR TESTING MACHINE—FOSTER INSTRUMENT COMPANY.

Another style of pyrometers shown is the thermo-couple type. It will be shown working with both Hoskins' patent chromel-alumel thermo-couples as well as with platinum-platinum-rhodium. It is shown both fixed and portable, and indicating and recording. The recording type is fitted with an automatic temperature alarm.

Of thermometers, there is shown an electrical-resistance type, shown in fixed indicating form, complete outfit with battery and lamp to illuminate the indicator. It is a special patented design, which renders the operation independent of any change in the battery voltage. It is particularly suitable for relatively-low temperatures.

Another interesting exhibit is the Humfrey autographic notched-bar testing machine, for measuring the energy absorbed in breaking notched specimens in a manner similar to the Charpy or Izod tests, but, in addition, drawing a "graph" showing how the test-piece broke.

Another testing machine, the Eden-Foster repeated impact of the Stanton type, is of much interest to foundrymen. It is used for testing the resistance of materials to "fatigue" or a succession of small shocks

JOHN MACDONALD & COMPANY.

This firm is showing a full range of Cleveland pneumatic chipping hammers from those suitable for the very lightest dressing up to heaviest chipping. Also a series of pneumatic sand rammers for bench and floor work, and Cleveland portable grinders are being shown in two sizes.

Other features are the "Bowes" automatic couplings, and "Cleco" pressure-seated air valves for the air-service piping in connection with pneumatic tools, these various fittings being shown in use. A portable electric sand riddle provided with an oscillatory motion, which has many excellent features, is also being exhibited.

GENERAL FOUNDRY AND ENGINEERING COMPANY, Lutterworth.

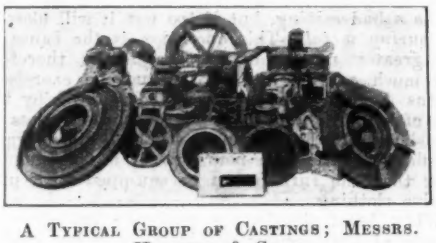
The general hand-operated moulding machine is the speciality of this house. Though this machine has recently been fully described in our columns, it may be well to point out its salient features.

It is claimed for the "General" that from first to last no skilled labour is required, not even for pattern drawing, so simple is the machine in construction and operation. An outstanding feature is the manner of raising and lowering the pattern plate by means of vertical shafts which are operated not by short toggles near the bottom but by comparatively long connecting rods which engage the vertical shafts well up. The connecting rods at the lower end work on long cranks from the horizontal crankshaft. As a result of these features very small effort is required at any time to raise or lower the pattern plate, and a much deeper draft than usual is possible with perfect steadiness and rigidity. The amount of draft can be regulated at will according to the depth of the pattern being used and the amount of clearance necessary. The vertical shafts are supported at the lower ends on stirrup bars to each end of which a wire rope is attached. These ropes are carried up over jockey pulleys mounted in bearings in the standards, and have a counter weight on each at their free ends. The weight may be varied as required, and in the larger machines, in order to counterbalance any weight of pattern plate, a saddle is suspended between the balance ropes. On this saddle is loaded whatever weight is necessary.

To ensure an accurate draw, which is particularly desirable in a deep draft, the pattern plate is locked in a plane truly at right angles to the axis of the vertical shafts by means of a pivoted trip stop and locking catch on the upper end of one of the trunnions. The plate itself is carried by trunnion brackets mounted on trunnions carried to the upper end of the two vertical shafts, and is prevented from when the locking catch engages with the bracket. The arrangement firmly locks the plate absolutely horizontal, and is most simple in operation. The machines are provided with the customary tram rails for removing the finished mould.

HERRING & SONS, Ironfounders and Engineers, Chertsey.

This firm have confined their exhibit to representative samples of the castings regularly produced in their foundries, which include grey iron, up to 3 tons, bronze and aluminium.



A TYPICAL GROUP OF CASTINGS; MESSRS. HERRING & SONS.

JOHN WILLIAMS (BIRMINGHAM SAND), LTD., Birmingham.

The special feature of Birmingham foundry sand, which this firm is exhibiting, is its loamy nature, power of taking up water to the extent of 5 to 10 per cent. of its own weight, bond and adaptability to produce clean castings in all kinds of metals.

Their other exhibits include ground coal dust (charcoal blackings) and plumbago, disintegrated, moxley sands, pig bed sands, sand blasting and silica sands, washed and unwashed, steel casting sands, cupola sands, sea sands, Trent polishing sands, ganister and limestone.

UNITED BRASS FOUNDERS AND ENGINEERS, LTD., Manchester.

This firm are showing a patent pig-breaker.

Industrial Developments in Westphalia.

Following an investigation of the developments now proceeding in Rhenish-Westphalian industries, a representative of the "Frankfurter Zeitung" states that as a consequence of the continued scarcity of coke, blast-furnace plants have been so little able to meet the requirements of the market that the Pig-Iron Syndicate has been compelled to place orders for considerable quantities of pig-iron in Middlesbrough and in Lorraine, the tonnage from the latter being reported to have risen to a rate of 30,000 tons per month. Large supplies of semi-finished materials and of bars are also being delivered to German works from Lorraine, and even the Central Railway Board has recently ordered Lorraine sleepers because they were cheaper and could be obtained more quickly than in Germany.

There is no uniformity in the restrictions on the production. At present the Gutehoffnungshütte has only five blast furnaces out of eleven in operation, as against seven blowing last autumn; the Hœsch Steel Works Company has three blast furnaces at work out of seven; the Phœnix Steel Company has eleven active out of nineteen; and at the Friedrich Alfred Hütte, of the Krupp Company, at Rheinhausen, seven out of the existing ten are in service. These restrictions are ascribed to the increase in the delivery of coke on reparations account, and under pressure of further demands a new reduction of 10 per cent. in the consumption of coke has been ordered.

Evidence of the embarrassments in regard to supplies of coal and coke that are being experienced in many places is to be found in the fact that English coal, which in recent months has overcome the high exchange barricade, has again established itself in its former districts of consumption on the German coast and in the hinterland (Berlin Gasworks); and has even found its way to works in the centres of coal production, as, for instance, those of the Krupp Company. Lubeck blast furnaces are now purchasing English coal, which is handed on to the German railways in exchange for coke. Similar interchange transactions are also being made by the Stinnes Group, which is said to be importing 30,000 tons of English coal monthly for the firing of locomotives, so as to release German coke for the Austrian Alpine Montan Company. In another way the scarcity of coke is also acutely felt at the ironworks, because earlier contracts for ore were concluded on the basis of a production which no longer exists at many works, and, as a consequence, the stocks of ore are accumulating, while the bills necessary for use in payment for the ore are not available to the necessary extent owing to the reduction in the export of manufactures. Apparently the consumption of minette is declining, as the lack of coke is compelling the works to use a charge of high-percentage ore and scrap.

The Phœnix Company is extending its pig-iron capacity at Hœrde, and intends to develop the production of tubes at Düsseldorf. Apart from the contemplated works at Rauxel, the Klockner Group proposes to expend 500,000,000 marks at the Georgs-Marien Works, and erect a new blast-furnace plant at the Mannstaedt Works, while the antiquated State Works at Wasseralfinger are to be modernised by the Gutehoffnungshütte. In addition, an expenditure of 1,500,000,000 marks is to be made by the Henschel Company for the erection of a new steel works and 100 coking ovens at the Henrichshütte, while the Krupp Company has now put into operation its new rolling-mill plant for superior qualities of wire.

Specifications for Aircraft Materials.—The British Engineering Standards Association have issued the following Specifications and Notes:—(1) British Standard of Reference for Aircraft Dope and Protective Covering; (2) Aluminium Tubes; (3) Heat Treatment of Wrought Y Alloy; (4) Heat Treatment of Duralumin; (5) Conditions for the Storage of Seasoned Aircraft Timber.

C

Safety Work in Foundries.*

By R. W. Patmore (London), of the Industrial Welfare Society.

The Need for Safety.

According to the "Labour Gazette" and other sources of information it is shown that during the last twelve months an average of three men have been killed each month, and 5 per cent. of the workers engaged in foundry work are injured annually in the foundries of Great Britain. While the percentage of accidents in this particular branch of industry may not be so high as in some other branches (and it must be remembered that the figures and percentage quoted only refer to molten metal and does not include conversion of metal), they are high enough to warrant serious consideration, and the author hopes the subject of his paper will lead not only to a mere discussion by the Foundrymen's Institution, but an actual campaign which will not cease until it has made the foundry the safest occupation in any industry.

Never was there a time in our industrial history when it was so necessary to eliminate accidents; from now on this country will have to face a severe competition to secure the markets of the world, and every unit in this country will have to utilise all its resources, all its strength, to secure and maintain its position in the industrial world. Not by force of arms will any nation gain supremacy, but by using to the full all the man-productive power (both brain and brawn) of its citizens; Great Britain cannot afford to be unnecessarily handicapped in this race, because of accidents or lack of industrial co-operation.

Employers' Responsibility.

For many years employers have been talking about accident prevention, and in 1912 the Institution set up a committee to formulate certain rules in order to avoid accidents. No doubt many employers have made up their mind as to what shall constitute safety precautions, and some have not, but we must all at least think about it. There is a tendency, due perhaps to some psychological action of the mind, among some engaged in the metal industry, to think, because of the nature of the work, that it is impossible to eliminate accidents. While it is not yet possible to operate a foundry on a 100 per cent. record without accidents for an indefinite period, it should be the aim and object of every managing director of a company operating a foundry to attain this happy condition.

One of the human instincts (inherent in every person) is to avoid pain and suffering. The spring of human sympathy is just as deep and pure among employers as it is among the employees, therefore surely every member of the Institution of British Foundrymen is seeking the best methods, and the best way, to place his plant among the 100 per cent. record of no accidents.

Analysis of Foundry Work.

At this juncture it should be understood that the author is not a moulder by trade, or connected with the foundry by profession; his only direct contact with a foundry was when he was apprenticed to the engineering branch of the metal industry. He then spent six months of that apprenticeship in the foundry, which was connected with the works. However, in his experience as a production engineer he has had to lay out operation sheets—therefore, in order that the subject can be understood better it is proposed to outline the ordinary operations which take place in a foundry, from the time the pattern is received until the casting leaves the foundry, after which the nature of accidents that sometimes occur in connection with each operation will be dealt with, and suggestions put forward as to how they may be avoided.

Operations in the Foundry.

In the ordinary way these may be set out as follows:—(1) Laying surface board and pattern; (2) placing drag; (3) riddling sand for facing and set nails; (4) shovelling in heavy sand, ramming, venting drag and sticking off; (5) clamping and rolling over; (6) making joint or joints, and riddling sand for facing; (7) placing cope or top; (8) setting gaggers; (9) riddling sand and tucking bars; (10) lifting off and finishing cope or top; (11) drawing pattern from drag, finishing and setting cores; (12) closing mould; (13) clamping mould; (14) building runner; (15) pouring metal; (16) taking out casting; (17) cleaning casting; (18) dispatching casting.

Causes of Accident (Major and Minor).

Placing drag.—The fingers may be trapped or foot squeezed because the men are watching to place the drag square with pattern.

Riddling sand for facing and set nails.—When riddling sand the moulder is apt to rub his hand over the sand; very often slugs are hidden in the sand which cut the flesh.

Shovelling in heavy sand, ramming, venting drag, and striking off.—Great care must be taken to have a proper vent. A poor vent not only creates bubbles and blow-holes, but may be the cause of an explosion.

Clamping and rolling over.—When this operation is being carried out by use of the crane, men should stand clear, even though the box may be properly swung, as the handles, owing to crystallisation, may snap. If roller chains are used hands must be kept clear of the chain.

Placing cope or top.—Fingers get trapped owing to watching the guiding marks.

Riddling sand and tucking bars.—Same accidents as operation No. 3.

Lifting off and finishing cope.—Same as No. 5.

Drawing pattern from drag, finishing and setting cores.—It is a common practice among moulders to use an old file and drive the tang end into the pattern; if a file is not handy a spike is used. Using a file is very dangerous, and the cause of many injuries to the eye; the file is apt to pull out, or in driving it into the pattern pieces of file fly. Wood screws with proper handles should be supplied to each moulder, and insist that they be used.

Clamping mould.—In clamping mould it is necessary to see that bolts or clamps are used instead of cotter pins, to examine the bolts, and to see that the threads are not stripped.

Building Runner.—A bad runner will not only make a bad casting, but if too wet it will blow.

Pouring metal.—This operation is the cause of the greatest number of major accidents, therefore too much caution and care cannot be exercised. Burns from molten metal can be reduced by the use of leggings with flaps to cover the eyelets of the shoes, also by wearing asbestos boots. Goggles should be worn when pouring. It is very important that the furnacemen be equipped with protective clothing.

When hand shanks are used the executive in charge of the foundry should make it his special duty to see that the gangways are clear, and pathways as level as possible.

Care must be taken to prevent foot plates, when used as pathways, from raising up; if they do men are liable to catch their toe and trip. They should be sprinkled with dry gravel when pouring takes place.

All cranes should be fitted with gongs so that when molten metal is being carried over the heads of the moulders they will be warned.

All chains should be tested every twelve months, and the maximum load stamped in plain figures.

Taking out casting.—Same as No. 5.

Cleaning casting.—The foundry cleaning room is one of the most difficult departments in the elimination of minor accidents. Eye trouble and deep scratches are the most common. It is not within the province of this Paper to deal with dust. It is very important that methods should be applied in every fettling shop to eliminate dust, because of the injurious effect upon the respiratory organs of those employed as fettlers. Poor

* A Paper read before the Birmingham Conference of the Institution of British Foundrymen.

health is so often the cause of discontent and inefficiency.

The difficulty of getting workmen to wear goggles is largely overcome when they are made to suit the sight of the operator. A man cannot be expected to wear goggles which, after wearing for about ten or fifteen minutes, make the eyes ache, any more than one would wear glasses to read with that made the eyes ache. Manufacturers of goggles, especially in the United States, are paying particular attention to this problem, and when speaking to representatives, before making purchases, they have been willing for me to call men in and try out several lenses before the sale took effect.

It is also recommended that a man be allowed to retain in his possession while employed with the company the pair of goggles that suit him best.

The steaming of the lenses is also another problem which is receiving careful attention. The author understands this is being overcome, and a metal pencil is now on the market.

Danger of Emery Wheels.

Every possibility of danger cannot be eliminated from grinding wheels when revolving at a high speed. The wheel may be chosen with great care, and be sound in every respect, yet there are many things that can happen to cause a wheel to break—a sudden jam will sometimes cause a wheel to burst. To minimise the results of a bursting wheel is to have the safeguards properly attached to the machine.

Machine Operation.

There is no doubt in the author's mind that the use of machines in foundry moulding is as permanent and evolutionary as the machine is in other spheres of industrial activity, and as far as he can discern the moulding machine cannot be classed as hazardous, but care will have to be taken by the operatives in seeing that the box is firmly and properly secured, so that the jarring of machine will not loosen the bolts. Lock or spring washers being used besides the nut are to be recommended.

Safety and Accident Prevention.

The managing director who would render conscientious safety service must first of all make his plant as reasonably safeguarded and ventilated as his resources permit. He must also get the best illumination possible. It has been the author's privilege to visit some foundries since his return to this country, and he is sure from what he has seen that foundrymen are alive to these factors, but no doubt there are many foundries existing in Great Britain to-day where it is possible to make changes that will not only be beneficial from the viewpoint of a safety engineer, but from the production engineer as well. However, it may not be possible for the company to change the present conditions prevailing, but it is possible for every managing director to enthuse into his organisation the spirit of safety.

Safety and Personnel.

Successful safety work is not based upon pretence, and it is of vital importance that every effort, and opportunity, be taken of proving to the employees that the company is sincere; just posting a few bulletins on safety does not bring results. Experience in this work convinces those who have been actively engaged in accident prevention that success does attend if eternal vigilance is kept, as well as a determination to concentrate every energy, every resource necessary to minimise the number of accidents, or reduce them to the vanishing point.

It is very essential that the managing director sets himself the task to ensure that the policy of operating a safe foundry permeates right through his organisation. He must, as it were, test every link of the chain, see that it is sound and imbued with the same spirit and enthusiasm, in order that it be effectual. He must give the lead, especially to the foremen.

Foreman the Keystone of the Shop.

In any industrial establishment the foreman is the keystone of the structure, and too much care cannot be taken in the right selection of foremen. The author's experience has taught him that the men in the department gauge the management by the actions of the foreman. Many boards of directors, managing directors, and general managers have received a shock when they realise that the policy, which had been the intention of the company, had failed to materialise, owing to the wrong interpretation being transmitted to the employees by the foreman. How could it be otherwise, unless the foreman has had the policy of the company explained to him instead of having to guess at it, or perhaps only learns it after he has been on the carpet? If the company has any labour policy, incorporating welfare and safety, the foreman should know of the policy, so that he can transmit it intelligently to those under his control.

The Foreman of To-morrow.

Industry is passing through many changes; one of the most important is the status of the foreman.

The foreman of the future will be the production manager of his department. He will be expected to secure the best results from the labour, machinery and material placed in his keeping; he will have to be a leader of men, display tact, diplomacy and patience. Many of our present-day mechanics, who may be thoroughly capable of doing good work, are slow in adapting themselves to the new conditions and new surroundings. It will be the duty of the foreman to secure for each man a square deal, and instruct the new employee in the little peculiarities of the shop, for it must be noted, and records of accidents prove, that a large percenatge of accidents occur among new employees. If the foreman inspires confidence he will be successful.

Another duty for which the foreman will have to be made responsible is the proper training of the boys. How many employers take the trouble to see whether the boys, or apprentices, to the trade, are taught to avoid doing things in the wrong way? Is it not the common expression to say, "He will get his usual number of bumps. I got mine, and he will learn better some day," but that some day may be too late. The foreman should see that each boy learns of the dangers of the work on which he is engaged, especially the occupational dangers which are inherent and peculiar to the trade. The author is of the opinion that it will be beneficial to the employers if instructors were employed to teach the boys in the foundry, instead of leaving the boy to pick up the trade under the present-day system. Every boy should know what he is doing and why he is doing it.

Co-operation of the Worker.

Having secured the co-operation of the managing director and the foreman towards the elimination of accidents, the problem is how to get the workman to co-operate. This is no easy task, and cannot be accomplished overnight, but by persistent education and patience.

Safety and Education.

Besides the usual method of having a safety committee it would be beneficial to explain to the workers that an accident has a threefold effect:—(1) Suffering to the injured person, causing distress of mind, not only to the person injured, but to those of his immediate relatives; (2) loss of time and wages to the injured person; (3) loss of production to the employer—(*a*) inability of the injured person to perform his usual duties, (*b*) breaking in a new employee.

Suffering and Discomfort.

The economic wastes resulting from carelessness is appalling, but those who stop for a moment to consider the sorrow and desolation which is brought into the home of the injured person by the lapse of thoughtfulness feel that they are spurred on to redouble their efforts in the work of accident prevention.

Loss of Time.

Methods should be devised to bring home to the injured person what accidents cost in the loss of wages. It may be imagined that this will be resented, and appear to be adding insult to injury,

but when you tell a workman in a tactful, diplomatic way, perhaps by letter, that he has lost so much wages because of a momentary lapse of thoughtfulness, he begins to think twice before taking risks and hazardous chances.

Loss of Production.

When an accident happens the human instinct is naturally aroused. Not only is the injured person unable to perform his duties, but his nearest workmates are interested to ascertain the extent of the injury, and also to render assistance. If the injury is severe, and will prevent the injured person from following his usual occupation for a period, he will have to be replaced, or the organisation rearranged to fill the gap.

Accident Costs are Production Costs.

Assuming that this is correct, the cost of each accident, with its subsequent loss of output, should be charged up to the department. Surely there is no more logical and better way of bringing safety to the attention of the superintendent or foreman than by adding to their operating costs the cost of all accidents that happen in their department.

If you reduce accidents you inevitably reduce replacement of men, and any industrial engineer knows that the replacement of absent men and temporary disorganisation means decreased production.

Every industrial problem, and especially the accident problem, when boiled down to the last analysis is the man problem. No matter how we analyse the accident or invent safety devices, have general campaigns on "Safety First," we are forced to come back to the individual—the human factor. We must win him, body and soul, to the cause and enrol him under the banner of safety scouts; therefore the author is a firm believer in securing the co-operation of each individual worker, and for this purpose he submits a pledge to which the worker should be asked to subscribe his bond when employed.

The Individual Pledge.

Believing that a careful man is the best safety device, a workman on joining a firm should be asked to pledge himself to (1) keep himself fit, good health being the essential requisite for all things; (2) report to the ambulance room for treatment upon the receipt of the smallest wound or scratch, the neglect of which may result in blood-poisoning and death; (3) use all safety appliances, clothing and guards which have been provided for him and his fellow-workmen, and to see that they are taken care of, kept and used in their proper places; (4) not to wear loose clothing around moving machinery; (5) not to use unsafe tools, but to report the same to his foreman; (6) to wear goggles when pouring, grinding and chipping, or performing any operation where material may fly and cause injury to the eye; (7) to keep the floor space in the immediate vicinity of his work clear of objects over which he or others may fall; (8) to be careful in handling and piling material so that no serious injury may result to passers-by; (9) to be just as careful of a fellow-workman's life as he is of his own, remembering that he, too, may have dependents; (10) to report to the foreman at once all unsafe conditions and practices which may come to his knowledge.

Education and Safety.

In addition to the individual pledge, great success has resulted through the cinema. The author recalls one film which his friend Mr. Tenner, one of the safety engineers of the U.S. Steel Corporation, used to exhibit, called "Steel Town." While the condition and types of employees are different in America from those of Great Britain, it is a psychological fact that the brain records a more lasting impression on any subject or object when transmitted through the medium of the eye than that of the ear, so it is to be hoped that a time will come when those responsible for manufacturing films, and those conducting cinema theatres, will co-operate with those responsible for industry to exhibit a film having for its purpose the necessity of using caution and thought in daily occupation.

The day must come—and sooner the better—when educationists will see the necessity of including in the curricula of the schools some simple lectures on accident prevention, in order to train the boys and girls in the elementary principles of safety, so that when they go out into the world they will be better equipped mentally to avoid the common dangers connected with their vocation.

First Aid.

A Paper on safety would not be complete unless reference was made to the rendering of First Aid to the injured. When an accident happens every facility should be at hand to relieve as quickly as possible the pain and distress of mind. It would be of great advantage if every worker would voluntarily take a course of instruction in First Aid to the injured, so that they would be prepared to render efficient help in time of need.

While it may not be within the province of this Paper to outline what should constitute a well-equipped first-aid station, the author takes the liberty of calling attention to the Home Office regulation, dated 1917, No. 1,067, "First Aid and Ambulance Station in Foundries":—

"In every foundry to which this Order applies, and in which the total number of persons employed is 25 or more, the occupier shall provide, in readily accessible positions, 'First Aid' boxes or cupboards in the proportion of at least one to every 150 persons.

"The number of 'First Aid' boxes or cupboards required under this provision shall be calculated on the largest number of persons employed at any one time, and any odd number of persons less than 150 shall be reckoned as 150.

"Provided (1) that an ambulance room maintained in conformity with paragraphs 6, 7, and 8 of this Order may be counted as one of the 'First Aid' boxes or cupboards required by this Order; (2) that the requirement of 'First Aid' boxes or cupboards shall not apply to a blast furnace if an ambulance room is provided and maintained as aforesaid.

"Each 'First Aid' box or cupboard shall contain at least:—(1) A copy of the 'First Aid' leaflet issued by the Factory Department of the Home Office; (2) three dozen small size sterilised dressings for injured fingers; (3) one dozen medium size sterilised dressings for injured hands or feet; (4) one dozen large size sterilised dressings for other injured parts; (5) one bottle of eye drops; and (6) sterilised cotton wool.

"Each 'First Aid' cupboard shall be distinctively marked, and if newly provided after the date of this Order shall be marked plainly with a white cross on a red ground.

"Nothing except appliances or requisites for 'First Aid' shall be kept in a 'First Aid' box or cupboard.

"Each 'First Aid' cupboard shall be kept stocked and in good order, and shall be placed under the charge of a responsible person who shall always be readily available during working hours.

"A notice or notices shall be affixed in every workroom, stating the name of the person in charge of the 'First Aid' box or cupboard provided in respect of that room.

Ambulance Room.

"In every factory to which this Order applies and in which the total number of persons employed is 500 or more, the occupier shall provide and maintain in good order an ambulance room.

"The ambulance room shall be a separate room used only for the purpose of treatment and rest. It shall have a floor space of not less than 100 sq. ft. and smooth, hard and impervious walls and floor, and shall be provided with ample means of natural and artificial lighting. It shall contain at least:—(1) A glazed sink with hot and cold water always available; (2) a table with a smooth top; (3) means for sterilising instruments; (4) a supply of suitable dressings, bandages, and splints; (5) a couch; (6) a stretcher.

"Where persons of both sexes are employed arrangements shall be made at the ambulance room for their separate treatment.

"The ambulance room shall be placed under the charge of a qualified nurse, or other person, trained in 'First Aid,' who shall always be readily available during working hours, and shall keep a

record of all cases of accident and sickness treated at the room.

Ambulance Carriage.

"At every foundry to which this Order applies, and in which the total number of persons employed is 500 or more, the occupier shall, for the purpose of the removal of serious cases of accident or sickness, provide on the premises and maintain in good condition a suitably constructed ambulance carriage, unless he has made arrangements for obtaining such a carriage when required from a hospital or other place in telephonic communication with the factory."

It is recommended that every member of the Institute will look upon these regulations as the minimum and not the maximum requirements.

Having outlined some of the causes of accidents in a foundry, and in a brief way suggested methods as to how they may be avoided, the author hopes that as the result of this session the number of accidents in this industrial occupation will not only be reduced, but eliminated altogether. It has been said that "nothing is impossible, but it takes little longer time to do it."

This no doubt applies to the problem of accident prevention. Let each and every one engaged in industry make as his slogan, "*No accidents to-day.*"

The Manufacture of Light Steel Castings.*

By H. Bradley (Sheffield).

In this Paper, which has reference to the practice of light steel castings, any reference to academic or laboratory practice has been purposely omitted. It is dealt with from the author's practical experience of a general jobbing steel foundry, making all classes of steel castings from a few ounces up to 14 tons in the rough, and with metal of carbon content varying from 0.08 to 1 per cent. and over, and additionally in chrome and manganese steels.

The Plan of the Foundry.

To run a foundry successfully, the largest output with the minimum amount of handling must be attained. To carry out this successfully, the shop should be planned for the pattern to enter at one end (where there should be shelves or pockets to receive it) and the core boxes with card attached, with works order number, description, and quantity off. The card is ruled at back, so that each day's cast may be entered thereon. When the pattern and core boxes are given to the moulder the card should have the man's check number marked on, together with the date.

When possible there should be a separate bay for dry sand moulds. The work for dry sand should be commenced at the end of the shop, then carried down to the drying ovens, then to the closing and casting floor, where the moulds should be arranged in straight lines, and all runner bushes should be as near one height as possible, so as to avoid hoisting or lowering the ladle. The steel plant should then be fixed as near as convenient, utilising the floor nearest to it for the green-sand moulds, as these are generally of the lightest section of castings, and, therefore, require the steel when in its most fluid state, to avoid short- or faint-run cast ings.

When the steel is a little on the stiff side it can be used for the thicker section castings. The boxes, after casting, should then pass on a little further to be knocked out and examined, and a note taken of the good and defective castings and recorded on the back of the above-mentioned card. When the job is completed the card should then be handed in to the foundry office, the castings going forward to the cleaning or dressing shop, which should be at right angles to the moulding shop, with tram lines running from one to the other.

The fettling or dressing shop should be equipped with shot-blast plant, oxy-acetylene burning plant, and both circular and band saws, according to size and class of work and output. The castings should then go to the machine shop and despatch shed.

The Making of Castings.

The first thing to consider is the pattern making, which depends, firstly, on the quantities of castings required from each. A good wood pattern will withstand the making of 500 castings from it, either by hand or machine. If repetition work is carried out, then either brass or white-metal patterns are necessary, which should be on the machine for small castings. The author prefers the hydraulic machine for boxes up to 24 in. round or square, and for deep-lift pattern the roll-over machine. For anything over 24 in. the jarring machine can be used to better advantage.

The difference in making a pattern for machine moulding and hand moulding is that it is always necessary to fix core-prints to the pattern for the former under any parts that are undercut, as the sand is jarring downwards, therefore, it naturally falls away from the underside of any projecting part.

Tackle.—The boxes should be strong, light, and made of steel. They should all be interchangeable according to the various sizes either for hand or machine. The double lug box is best, giving a truer alignment. The double lug can be either a slot and hole or two holes.

For patterns with small quantities off and intricate joint, a plaster oddside should be made, as they are easy, cheap, and durable.

For large orders or repetition work, machines are a necessity. They do good in two ways, i.e., by reducing costs, and increasing output on the jobs they are working. They also speed the work up generally in the shop. Two boys working a machine with boxes 10 in. by 10 in. by 4½ in. have produced 180 complete moulds in the day with from two to four cores in each. Two youths, 17 to 18 years of age, have produced 62 moulds, 18½ in. by 16 in. by 5 in. deep, painted and blacked. The quantities vary according to size of boxes and design of castings. To get the full advantage from the larger machine it is essential there should be an electric crane specially for its use.

For large quantities of light castings the Tropenas vessel or electric furnace are to be recommended.

To ensure sound steel castings it is essential to have in the first place a good steel, that is, steel containing the correct composition for the work required, and properly "killed," in order to ensure it lying quietly in the mould. It is also as essential that the sand be suitable; if being used green, it should have just the correct moisture, and just sufficient bond to work it. Sand, in the first place, should always be dried before milling in order to get the required moisture by adding water, and the necessary binding material. The author prefers to use the natural sands whenever possible. The sands generally used in England for steel castings are Belgian loam, used either by itself or with a small amount of silver sand, cornish loam with silver sand, and Yorkshire sand with silver sand. Of the three mentioned, the author prefers Yorkshire, as it is easy to work, is tough, but not too close, gives a good skin on either dry- or green-moulded castings, and does not cake in the mill as much as the first two. For cores, the author's practice is to mix eight parts of silica to one of Yorkshire and up to 4 to 1 for moulds, varying, of course, according to weight and design.

Running and Feeding.

Where possible the best system is bottom runners, and in one of the thinner sections of the casting. Careful judgment is required for feeding heads to have the required size and in the right place in order to get a solid casting and avoid wasting steel.

Very soon after casting all runners and feeding heads should be released so as to enable the contraction to take place and avoid having a pull in the casting.

When the pattern is made, it should in the first place be taken into consideration as to whether the casting is to be made green or dry, and the decision generally arrived at is based on how much machining is to be done on the casting, and whether the difference in the two methods of mould-

* A Paper read before the Birmingham Conference of the Institution of British Foundrymen.

ing is worth the risk of making an unsound casting by making it in green sand. A further consideration depends upon design of the casting. In such cases it is essential to make it green to allow for the contraction strains taking place and preventing the casting pulling into pieces. In some cases the weight and design must be taken into consideration in deciding these points. If there is no danger of the casting pulling with a dry-sand mould owing to design, it is always much safer to produce a sound casting from dry-sand work than from green-sand work, owing to the properties of the steel used for casting. Of course, there are many different designs of castings to be contended with, and the greatest trouble given to a steel foundry manager is often caused by the designer not having had any steel foundry practice. To produce good, sound steel castings it should always be the aim to have the thicknesses of the metal as much alike as possible. Wherever thick or bulky pieces of steel are joined together with lighter sections, means have always to be found (if the design cannot be altered) to overcome the difficulties encountered. This can be achieved, either by using chills or causing the thick portion to freeze approximately at the same time as the thinner sections. In some cases, however, a reinforcement is used, but this is not always a wise policy, owing to the possibility of a mishap, after the casting is put to work, disclosing the reinforcement in any fracture. Naturally, the blame would straightaway be put down to this method. This can be further illustrated by a large mill pinion casting of, say, 2 ft. 6 in. tooth face by 3 ft. diameter in the tooth portion, reduced down to, say, 18 in. or so on the neck portion. The best method of producing this class of casting is to have it cored out. At times, however, it is found that engineers object to this method of coring out. They state they must have a solid casting. In order to meet their views, as far as possible (which steel founders, of course, have to do), it is endeavoured to produce a solid casting. This, however, is an impossibility without some method of reinforcement, as it is impossible to feed the body portion of the casting of the dimensions mentioned, through the size of the neck and the wobbler. Therefore, the method of reinforcement has to be used. This is accomplished by putting in what is called locally a "dummy," sufficiently large to prevent the pipe forming through the top neck and wobbler, which would take place unless something of this description was carried out.

Again in the case of hydraulic cylinders, in most steel foundries, there does not seem to be any set way in which to cast them. This is done, either mouth downwards or upwards, but in any case there should be taken into consideration the location of the large bulk of the steel, and the best means of feeding it. As will be realised, it is necessary to feed all steel castings from the head. In iron foundries, a wrought-iron or mild steel feeding rod is used, and small shanks of metal are poured in time after time until it is set. This method cannot be adopted in a steel foundry, as it would pull out the steel instead of causing it to become more solid as in the case of iron castings.

Another useful illustration is that of locomotive castings. The various parts of these are rather troublesome to make, owing to the varying thicknesses of the strengthening brackets, and it is necessary to give much consideration before starting work, otherwise much trouble is certain to result. These castings, are very often made as light as possible, and thick and thin sections are more usually encountered in this class of casting than in most other classes of work.

Core Making.

The Core Shop should be self-contained, with special drying ovens, as these play an important part in the making of good castings. The stoves should have facilities for eliminating the moisture as most cores are made either with oil-sands or Bindsandrite, which under the slow baking throws off a lot of steam or moisture. The sand for cores should be very carefully regulated for different classes of work, should be very refractory with just sufficient bond to stand up to the steel, as there are so many castings which if the core does not collapse very quickly would be wasters; especially in manganese castings such as tramway points and crossings, owing to the contraction. A machine for making standard cores is a great help, as ordinary standard round cores can be stocked and kept in dry places. Obviously it produces a better core as wooden boxes get out of shape.

Fettling.

Cleaning plays a very important part in the costs, and is always a greater speculation than any other process, owing to so many contributory causes. It may be the sand, or the "compo," but generally, in the author's opinion, it is owing to casting the steel at wrong temperatures. It will be realised that with a ladle of steel, varying from, say, 36 cwt. to 56 cwt., it is almost impossible to have sufficient moulds on the floor at one time to take it at its varying temperatures to suit all castings. But many of the troubles in this department can certainly be overcome with a good shot-blast plant, pneumatic hammers, and swing grinders. There are three methods of removing the feeding heads—burning, sawing, and cutting by the lathe, and obviously the choice will be determined by the design of the casting.

Annealing.

It is obvious that the question of annealing depends largely upon the size of the foundry, and output. The best method, in the author's opinion, is the gas-fired stove, but for general jobbing work, where all classes have to be dealt with, the moveable top is as cheap as any for fairly large quantities. For quick and urgent work—say where it is required to cast one day and deliver the next—a small handy furnace of about 8 ft. by 5 ft. with a door at the front of the furnace can be built, and operated with lever and balance weight.

In conclusion, there are many other points appertaining to the manufacture of steel castings, but those enumerated should be sufficient to provoke an interesting and profitable discussion.

Overcoming Wasters, II.

The Work of a "Sand Rat."

Most people say that wasters can be avoided, and while this may be true in most cases, the following will prove the exception.

A box of fire bars was moulded and closed on a Saturday, but not cast until Monday, so that the mould remained uncast for about 50 hours. A shank carrying 2 cwt. of metal would cast two boxes of these bars, but when this particular box was being cast all the 2 cwt. of metal was poured in and there was no sign of its being full, the

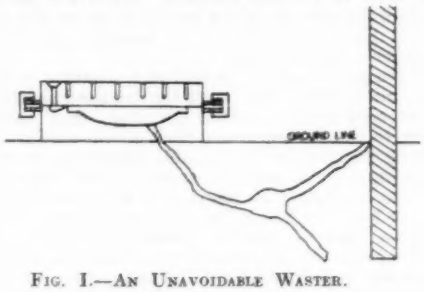


FIG. I.—AN UNAVOIDABLE WASTER.

following morning an investigation was held and it was discovered that a rat had burrowed from its run into the box of bars, as shown in Fig. I. It thus opened a channel for the molten metal to flow into its nest, this curious casting was dug up revealing the run, nest and junction which was of multifarious colours, showing that all kinds of material had been used to make the nest, and possibly some young rats were cremated.

THE INSTITUTION OF MINING ENGINEERS.—The seventy-seventh general meeting of the Institution of Mining Engineers was held at Sheffield, by invitation of the President and Council of the Midland Institute of Mining, Civil, and Mechanical Engineers, on Tuesday, Wednesday, and Thursday, June 20, 21 and 22, 1922, at the Cutlers' Hall, by kind permission of the Master Cutler.

The Works of Messrs. Allen Everitt & Sons, Ltd

This Works was included in the Institution of British Foundrymen's Programme of Visits.

The Kingston Metal Works, Smethwick, Birmingham, is the modern development of a business which was established in 1800 by Messrs. Allen Everitt and Sons, whose works were in Adderly Street, Liverpool Street, and Glover Street, Birmingham. These works were extended from time to time as the demand for the products of the firm increased, until the whole of the space available was occupied, so that when further additions to the works and plant became necessary a new site had to be found, and in 1890 the present site, comprising 16 acres, was acquired and the firm was incorporated as a limited liability company.

The choice of site was a very happy one, particularly as regards transport facilities. On the eastern side the works are served by the Birmingham to Wolverhampton low-level canal, from which an arm extends into the centre of the works. A branch of the high-level canal bounds the works on the west, whilst on the south is situated the Soho Station of the L. and N.-W. Railway, from which a private siding connects up with the works.

The productions of the company include solid drawn tubes of copper, brass, and special non-ferrous alloys for locomotive and marine boilers, condensers, steam, gas, and water conveyance, etc. A production of which they make a particular speciality is condenser tubes for the Admiralty and commercial services. Other manufactures include yellow metal condenser plates, Naval brass condenser plates, hot and cold rolled copper, and brass plates and sheets, copper and brass strips, rods, etc.

The works have gateway entrances into Bridge Street, Smethwick, on the one side, where also are situate the head offices of the company, and into Soho, in close proximity to Soho Station, on the other side.

For the casting of tubes, strip, plate, and small ingots there are fifteen shops, which are ranged in two lines. Each shop is served with from five to six pot holes, melting charges from 125 lbs. and ranging up to 900 lbs. Between the lines of casting shops is a range of buildings laid off for the core shop, sand plant, ingot stores and crucible stores.

We then pass to the metal stores, which is divided into two bays, the one serving for the storage of virgin metal, and in which a set of shears is installed for cutting the ingots. The adjoining bay is laid out with a series of bins in which is stored the classified scrap; here also all heats for the whole of the casting shops are made up and weighed.

A separate foundry formerly housed a battery of 6,600-lb Morgan tilting furnaces. The whole of these, however, have now been dismantled, their duty being taken over by electric furnaces. The first Baily furnace of one-ton melting capacity was started up in January of last year, and, running continuously ever since, has just been put out for re-lining. A second similar furnace is in course of erection. In the meantime the total capacity of the casting shops is 400 tons per week.

The billets for the solid drawn tubes are cast solid and pass from the casting shop to the piercing shop. The billets, after heating in a Gibbons continuous furnace, are pierced on a Gilbert Phillips machine. The machine, illustrated, is capable of piercing a hole 6 in. dia. through solid metal; a similar but larger machine pierces and expands tubes up to 15 in. dia. A very considerable amount of mechanical work is put on the material by this process. The solid billets first pass between conical rolls, which revolve them at a high speed and carry them forward to the point of a piercing mandril. It is a feature of the machine that the internal diameter of the tube produced is greater than the external diameter of the original billet. This great displacement of metal at a high temperature results in the production of tubes having a uniform, fine-grained crystalline structure, giving a high tensile strength, combined with a maximum ductility and malleability. The machine is driven by two Mather & Platt motors, each of 180 h.p. The pierced shells pass from the machine into a bosh for quenching and the removal of scale. The ends are next sawn off and the shell passes to the other side of the shop, where the shoulder is formed under a Pilkington hammer. The tube is then drawn in one of the two 200-ton hydraulic benches upon which tubes can be drawn up to 18 ft. in length and 12 in. in diameter. Space is provided in the shop for the storage of mandril bars, so that the labour of changing is reduced to a minimum. Power for each press is supplied by a Hawthorn-Davey three-throw pump, which is driven by a 220-h.p. motor. There are three coal-fired furnaces for annealing the tubes after drawing before same are passed to the finishing shops.

Billets for the brass tubes are delivered from the casting to the preparing shop, where they are

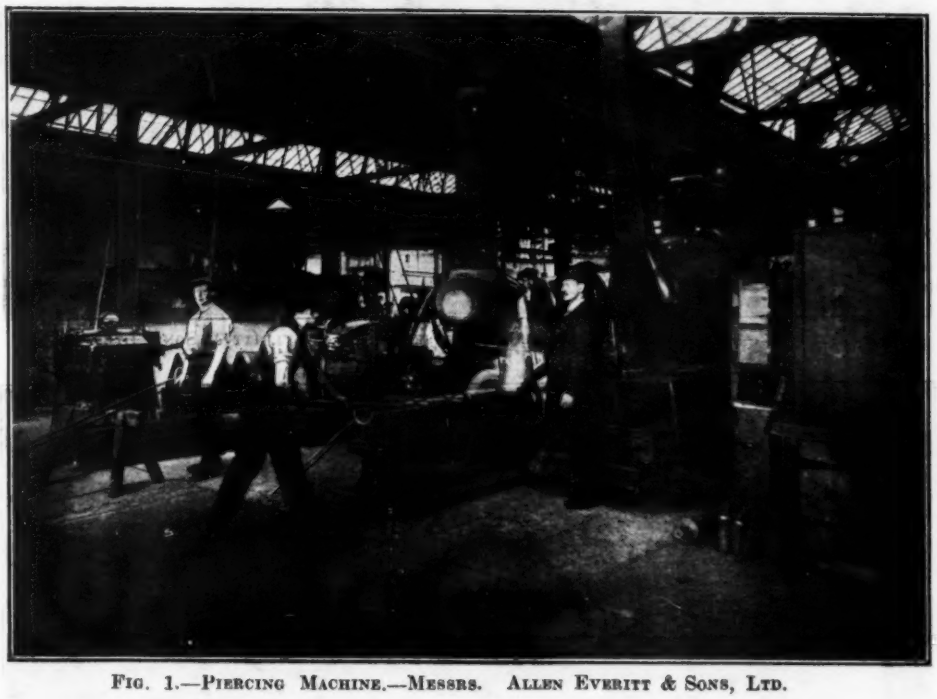


FIG. 1.—PIERCING MACHINE.—MESSRS. ALLEN EVERITT & SONS, LTD.

turned on the outside and bored inside on lathes specially designed for the duty.

The whole of the tube mills are housed together, though for all practical purposes they constitute four self-contained and entirely independent units for dealing respectively with copper tubes, brass tubes, commercial condenser tubes, and Admiralty condenser tubes.

the tubes. For this heat treatment there are six muffle furnaces; these furnaces are fired by producer gas and are fitted with recording pyrometers. After annealing, the tubes are cleaned with diluted sulphuric acid to remove any slight film of oxide which may result from the annealing process and to ensure a highly polished surface after drawing. The auxiliary equipment of the mill comprises four

Fig. 2.—Brass Tube Department.—Messrs. Allen Everitt & Sons, Ltd.

Fig. 3.—Condenser Tube Department.—Messrs. Allen Everitt & Sons, Ltd.

The copper tube mill comprises 23 draw-benches, upon which tubes are produced of all commercial sizes from ⅛ in. dia. upwards and in various lengths; for special purposes, tubes up to 80 ft. long can be made.

The number of draws to which a billet may be subjected before it arrives at the finished stage varies with the diameter of the tube required, and may be any number (from three to ten or more), and between each draw it is necessary to anneal

hammers, nine saws, a proving bench, and a mandril turning lathe.

The brass tube mill comprises 21 benches. Upon those shown in the foreground of our illustration tubes up to 9 in. dia. are produced, whilst the remaining benches are employed in the manufacture of solid drawn brass boiler tubes for locomotives and brass pipes for general purposes. The mill equipment includes two hammers, two saws, and two muffle furnaces.

The commercial condenser tube mill is devoted exclusively to the production of solid drawn surface condenser tubes for the mercantile marine and land stations. No tubes are made in this department exceeding 1 in. dia., the principal size being ¾ in. dia. The mill comprises 15 draw-benches, which are served by a muffle furnace, three saws, and three hammers.

The general production of tubes are inspected in a separate department, in which are three 2,000 lb. hydraulic testing benches.

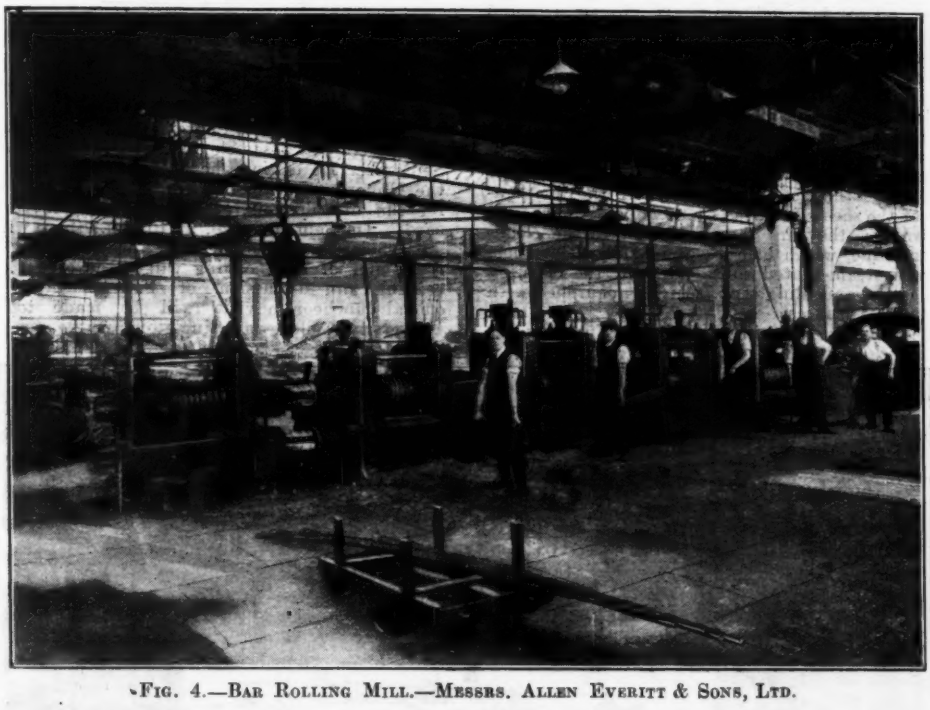


FIG. 4.—BAR ROLLING MILL.—MESSRS. ALLEN EVERITT & SONS, LTD.

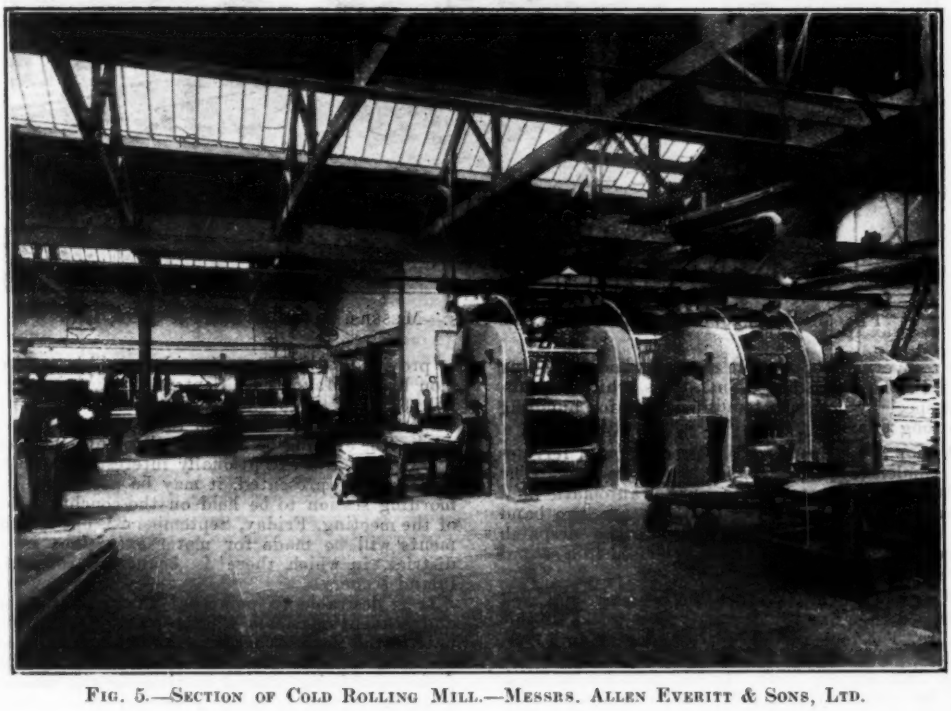


FIG. 5.—SECTION OF COLD ROLLING MILL.—MESSRS. ALLEN EVERITT & SONS, LTD.

The Admiralty condenser tube mill works, complete in itself, is used exclusively for the production of condenser tubes for Admiralty purposes, and to comply with the specifications and tests of the British Admiralty. The tubes are broken down for the finishing benches on eight special benches, which are served by three muffle furnaces, hammer, two saws, and a mandril lathe. The finishing department consists of 12 benches, with two muffle furnaces, two hammers, and four saws. Adjoining this mill is the Admiralty tube inspection department, which is laid out for cleaning, sighting, and examining the tubes prior to submitting them to the Admiralty officials for final inspection.

In the rolling mill department, as in the tube mill, the system of grouping has been adopted. Immediately at the entrance of this building is the bolt mill, which comprises three stands of 2-high rolls and is driven by a 250-h.p. Siemens motor. The mill is served by five Gibbons (Dudley) furnaces, and its duty is to roll rounds, squares, hexagons, and hollow rods up to 4½ in. dia. or equal. Such material produced on this mill which

has to be cold-drawn passes from the mill to the tagging hammer and thence to the draw-bench, which is driven by a Brooke 30-h.p. motor.

The sheet mills comprise two stands of hot rolls, 6 ft. by 22 ft. and 8 ft. by 24 ft. respectively, which are each fed by two furnaces and both driven by a Siemens reversing motor of 500 h.p. In front of each of these mills are five stands of cold rolls, the ten stands being driven by ropes from a 500-h.p. motor. Two hot mills, 24 ft. by 6 ft. and 24 ft. by 3 ft. respectively, are fed by two Price's patent furnaces and rope-driven from a 200-h.p. motor. In addition, there is a special mill with two stands of 30 in. rolls, which is rope-driven from a Siemens 200-h.p. motor. This mill is set apart for special cold finished work. The mill contains the usual auxiliaries, including three sets of guillotine shears and two rotary shears. At the end of the mill is the cleaning shop, where the temperature of the sheets is raised by their passage through hot water; they are then delivered to the cleaning machine, which brushes and finally dries them between steam-heated rolls. Beyond the cleaning shop is the annealing shop, which is equipped with six muffle furnaces.

The refinery is equipped with two furnaces for the recovery of copper, one of the furnaces standing by. In the weigh house and stores, which adjoins, is a specially designed bundling press for bundling the long swarf.

A shop is set apart for the production of ferrules for condenser tubes, copper stay bolts, etc. The tools for the most part comprise automatic and semi-automatic lathes, whilst there are two band saws for cutting off the ferrules. The despatch warehouse for the rolling mills is housed in a second bay under this roof.

The tool room is much more roomy and well equipped than one usually finds in a works of this nature. The tools include plain and capstan lathes, millers, grinders, and saw-sharpening machines for band and circular saws. In connection with these last Mr. Barnsley (engineer) has introduced a very important modification, the more interesting because so delightfully simple.

As our readers are aware, the usual practice consists of moving round the saw under the grinding disc by a pawl operating on the teeth of the saw as a ratchet, and it naturally follows that any irregularity in those teeth will be repeated with each successive grinding. Mr. Barnsley's patent consists of a dividing disc mounted on the spindle carrying the saw, into which the ratchet pawl meshes so that the grinding operations are always accurate and not, as with the usual method, affected by broken or faulty teeth.

A new laboratory has recently been built, the ground floor of which is laid out for physical testing, micro-photographic work, etc., and the first floor for analysis of materials as also for the conduct of experimental research work in connection with heat treatment, etc., etc.

FIG. 6.—HYDRAULIC TUBE DRAWING BENCHES.—MESSRS. ALLEN EVERITT & SONS, LTD.

The Institute of Metals.

Autumn Meeting in Swansea.

The Council announce that the annual autumn meeting will take place in Swansea on Wednesday, Thursday and Friday, September 20, 21 and 22.

Members will assemble in Swansea on Tuesday, September 19, during the afternoon of which day the Honorary Local Secretary's office will be open for the distribution of Papers and invitation cards. On September 20, at 10 a.m., there will be an official welcome by the Mayor, and the remainder of the morning will be devoted to the reading and discussion of Papers. After an official luncheon a visit will be made to the University College at Singleton, where tea will be provided. In the evening there will be a reception by the Mayor. On September 21 the morning will be devoted to the reading and discussion of Papers, and after luncheon there will be visits to works, the evening being devoted to entertainment.

Owing to the exceptionally interesting series of Papers to be presented, it may be necessary for a morning session to be held on the concluding day of the meeting, Friday, September 22, but arrangements will be made for motor excursions in the district, in which there is beautiful coast and inland scenery.

It is desirable to point out that only members and student members will be entitled to participate in the Swansea meeting, and that for the convenience of applicants for membership who are desirous of being elected in time for the meeting, a special ballot is being arranged in connection with which membership application forms should be received not later than noon on Thursday, July 13. The ballot will be concluded in time for members and student members so elected to participate in the Swansea meeting.

HIS MAJESTY'S Senior Trade Commissioner in India reports that the total import of cast-iron pipes was reduced from a crore to 96 lakhs. The British share, however, fell from 78 to 68 lakhs, in contrast with American shipments, which increased from 25 to 26 lakhs.

History of Loam Moulding in the Province of Liége.*

By J. Varlet, of the Esperance Longdoz Works, Liége (Belgium).

The origin of loam moulding dates from 1846, in which year it was practised for the first time in the Gomree Foundry—thanks to the enterprise of a working patternmaker named Pirson.

He was faced with the necessity of moulding a roll for which it was not convenient to make a pattern. Pirson conceived the idea of making the mould by striking up in a loam and using a spindle and strickle boards; these latter were for a long time called "Placards."

It was not till 1870 that loam moulding began to be generally adopted and that many large foundries decided to produce engine cylinders, condensers, and a number of parts for steam engines by this method. At this date the foundries of John Cockerill, John Roos, and A. Ketin already specialised in loam moulding, which they carried on in a systematic manner, and it is from this foundry that the science of loam moulding was disseminated. At that time there were only available a few exceptional workmen, such as the Marechals, the Galasses, Doyen, and Baguette.

These men, who were real artists, were the actual professors of the period, and it was with an almost fatherly interest that they taught young workmen this art of loam moulding, which is the most intellectual part of foundry work, and which requires the most complete knowledge of engineering design.

In this occupation the artist is revealed by the facility with which he handles the loam and by his insight and capacity for organising his work.

About 1880 loam moulding began to attract still more attention. Many young workmen interested themselves in this branch of foundry work, and there was a veritable rush into the new profession, which was considered a justifiable title, as being much superior to other sections of foundry work.

Course of Training for Loam Moulders.

The young men who had taken up foundry work had learnt sand moulding or perhaps coremaking; there were young coremakers who followed their inclination and their aptitude for the craft, and took up loam moulding after five or six years' apprenticeship to coremaking. Each of these young men had to go through a course of mechanical design, and in 1880 there was in the City of Liége only one professor, Monsieur Rosa, who taught mechanical design with special reference to moulding, and he never had less than 40 pupils. These lessons were given each Sunday for three hours, and the pupil paid 1 franc per lesson.

When the young coremaker was equal to reading his drawing and of making all the sections and views of a cylinder, condenser, pump, etc., and if he had the aptitude already mentioned, he made application with a view to entering the loam moulding department. There he was attached as assistant to a leading moulder, under whose tuition he perfected his workmanship, and in time became a leading loam moulder himself.

Notwithstanding this system of tuition there was not less than 60 to 70 per cent. of failures; that is to say, workmen who never rose above assistant loam moulders or were obliged to return to coremaking.

It was in 1890 that the number of loam moulders reached its height; large important foundries had 10 to 25. The work was at this period perfectly executed, and the cost of production reached its lowest level. In addition, it was not uncommon to see castings struck up in loam which had previously been moulded in sand. The general appearance and skin of these castings was much superior, and extraordinarily enough cost of production was lower than in the case of the same castings sand moulded (to-day the contrary would certainly be the case).

The Life of the Leading Loam Moulder in the Workshop and After the Day's Work.

If one examines the life of these workmen one cannot help being astonished to notice how much we have gone backward from the point of view of love of work.

The leading moulder was animated by a sincere love for his profession; he had the respect of his chiefs; he respected himself, and, above all, he conducted himself as an artisan of an intellectual profession, who had the right to everyone's consideration.

The loam moulder worked with his hands in the foundry and with his head at home. When he received from his employer the drawings for an important casting, he sometimes took them to a corner of the foundry for a preliminary study, but in any case he studied the drawings at home and organised his work for the next day.

Methods of Working.

At this period various works had adopted two methods differing widely from each other.

The first consisted in the moulder making a full-sized drawing on large wood panels of the casting he had to make. The second consisted in the moulder sketching out, after a preliminary study of the drawings handed to him, all the strickle plates and grids which he would need to make the casting.

The second method was much superior to the first. It required of the workman a deeper knowledge of the construction of the moulds, and the work was considerably more rapid.

In the method of making a lay-out to actual size a great deal of time was required by the moulder for the execution of these drawings. After that the workman familiarised himself with his drawings, which he consulted continually, and as in these views he saw all the mould faces, his comprehension and execution of his work was greatly facilitated, but his labour was less intellectual than in the other method. This process developed the workman but little, but tended to mechanical labour, and it is noticeable that the workmen who practised it were much less capable than others in the art of loam moulding and were less intelligent, whilst, in particular, they were slow in the production of their castings.

By the other method, on the contrary, the workmen very quickly conceived the complete construction of his mould, and one may say that when he had studied his drawing for an hour he could see the casting on all its faces. To quote here the old proverb:—

"One is only a loam moulder when one can see the completed casting one hour after having received the drawings." This means that after an hour of study a moulder should be able to foresee all that is necessary for the successful production of the casting.

The workmen practising the latter method were much more valuable than those of the other school, who were never able to compete with them either from the point of view of quality of work or speed of production.

Equipment.

In considering the tools employed by the loam moulders of that period one is forced to feel respect for these artisans and to recognise their exceptional ability in being able to produce such perfect results with such primitive tools, or almost none at all.

Whilst now we have available such modern tools as travelling cranes, jib cranes, forced draught mould dryers, special mould tubs, and numerous strickles—most of which are patented—machined plates, pneumatic tools for ramming up large castings, there was available, even in 1890, only crude equipment; the workman had to cut a centre with a chisel in a cast-iron plate so as to form a strickle, with a spindle often weighing 140-150 lbs. These strickles were fixed and had to be constantly checked with a plumb line; mould tubs did not exist. Instead, a hole was dug in the foundry, and in order to make sure of the work. the moulder made the hole much greater than the mould itself, so that there was always the space of about 3 to 4 ft. which had to be filled in with sand and rammed by hand. This great thickness was indispensable, seeing that in order to resist the pouring

* A Paper read before the Birmingham Conference of the Institution of British Foundrymen.

pressure of the metal, it was necessary to arrange a layer of pig-iron in the form of a grid so as to stiffen the walls of the mould. It was not uncommon for the cooling of a casting made in loam, such as the cylinder of a steam engine, to require three or four days to complete. The loam and the sand, in the condition of mortar, were mixed in a heap with a shovel and crushed with the feet or with a bar of iron, whereas to-day there is at our disposal sand mills and mixers of excellent design.

Loam Moulding at the Present Day.

Nowadays loam moulding is not so much practised, owing to the disappearance of certain types of steam engines. Foundries still have loam moulders, but these are employed as much on core-making as on moulding. Only some of the large works who still make occasionally steam engines, turbines, etc., have a section for loam moulders.

On the other hand, methods of work have changed; they are quicker when the work is convenient for repetition production, and as often as possible a duplex method is practised, part sand and part loam, as will be seen from the drawings which follow.

Loam Moulding.

A loam mould is composed:—(1) Of a base upon which the mould is built (this base is furnished with a strickle spindle when the casting in question is round). (2) Grids which follow the shape of the casting, which strengthen the mould and allow the parts to be lifted. (3) Red bricks and loam bricks, which form the bottom and the sides. (4) Loam (slurry), which forms the first layer covering the bricks. (5) Sand (slurry), which forms the last layer and constitutes the skin of the mould before the layer of blacking.

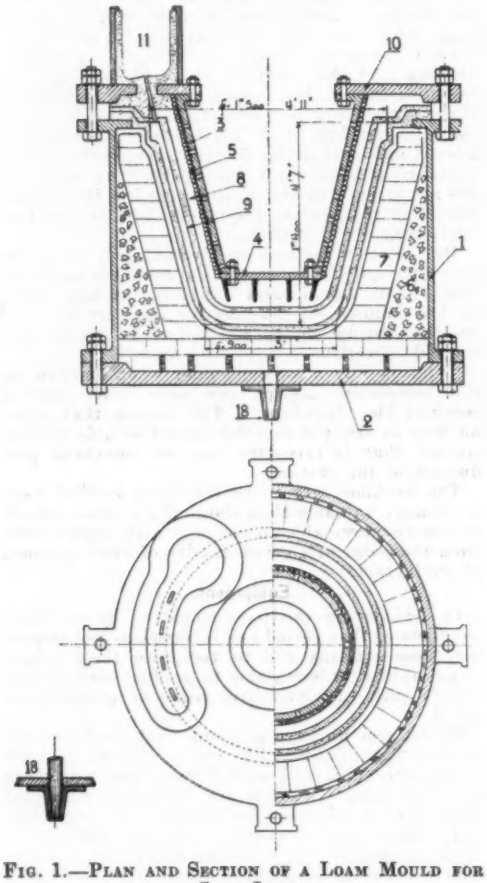


FIG. 1.—PLAN AND SECTION OF A LOAM MOULD FOR A SLAG LADLE.

The loam and sand mixtures are generally made up as follows:—

Loam Mixture.—Waste core sand and loam bricks 50, clay 20, old foundry sand 10, tan (tannery waste) 20 per cent., and water *ad lib.*

Sand Mixture, No. 1.—Quarry sand 75, horse manure 25 per cent., and water *ad lib.*

Analysis of Sand.—Silica 93.3, iron oxide 0.90. alumina 3.5, magnesia 0.10, lime 0.60, and calcination loss 1.50 per cent.

Sand Mixture, No. 2.—Quarry sand 68, horse manure 10, hard coke grindings 12, waste firebrick grindings 10 per cent., and water *ad lib.*

Sand mixture No. 1 is used for general purposes and No. 2 specially for castings of large area and great thickness.

Slag Ladle for Steelworks.

When a foundry is attached to steel works it has to make slag ladles regularly, for which the mould should be constructed as in Fig. 1, where (1) is a wrought or cast-iron shell; (2) a base bolted to the shell; (3) a core-iron bolted to a cover plate; (4) a bottom plate for core-iron, which must be unbolted before removing the core-iron from the core; (5) straw rope; (6) layer of sand; (7) red bricks; (8) loam mixture; (9) sand mixture, No. 2; (10) cast-iron cover; and (11) runner bush.

When a casting is poured, it is possible the same day or the next morning to lift the core-iron, which does not stick to the mould, the straw ropes being burnt. In cases where straw is not interposed between the sand and the core-iron, it is impossible to lift the latter owing to the contraction of the casting, and the labour of chiselling the core-iron free is very slow.

In cases where there is only one casting to make, the outside of the mould is made in sand and the core in loam without a core-iron, the latter being replaced by red bricks but still using straw rope as indicated. For repetition work it is sufficient after having lifted out the casting to remove the top layer of sand from the mould and sweep up again directly. In the case of the core, the straw, a layer of loam, and a layer of sand must all be replaced.

The maximum labour for this class of casting is 15 to 18 hours for one man. The weight of the casting is about 3 to 4 tons.

It is noticeable that the slag ladles have a longer life when moulded in loam than when moulded in sand, the iron being closer where in contact with loam surfaces. It is also noticeable that the interior is better finished by moulding in loam than when sand is used.

Composite Moulding of Large Flywheels, part Loam and part Sand.

Formerly heavy flywheels of large diameter (18 ft. to 23 ft. dia. or more), which were too large to be made in a single moulding box, necessitated a very great amount of labour, and occupied a large area of the foundry over a long period; often six to eight weeks passed by before valuable space thus occupied (90 to 110 sq. yards) could be recovered for the moulding of other castings. This slowness was due to the system of using small box parts for the rim and the arms and to the necessity

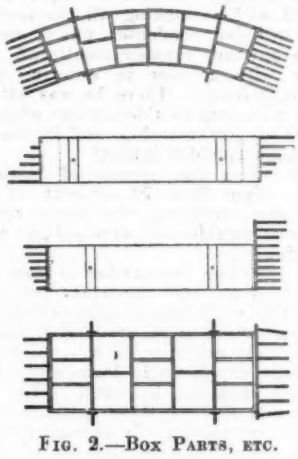


FIG. 2.—BOX PARTS, ETC.

of working up patterns for these parts and the enormous quantity of gaggers required to keep the sand in position in the small box parts, etc., shown in Fig. 2.

These box parts for the rim and the arms had to be finished at each end with grids, having wrought and cast iron pins, which were adjusted according to the shape to be followed at the hub and the

rim, which required considerable labour, as the box parts had to be tried on the mould many times before they could be definitely fixed in place.

The New Method.—The new method of moulding these large castings consists in making one part in loam, such as the top part mould of the rim and the arms.

The labour is greatly reduced, and it is possible to strike up the shape of the flywheel directly. Once the rim is strickled, and the hub made, it only remains to make the arms; one pattern will obviously enable these to be moulded in a minimum of time.

The loam part consists in making slabs to cover the rim (four or six according to size), a plate for the hub, and a slab for each arm. This work is very rapid; a coremaker can finish the whole in ten days.

For the arms, a pattern is made in tarred loam. The slab follows the contour of the arm, the rim,

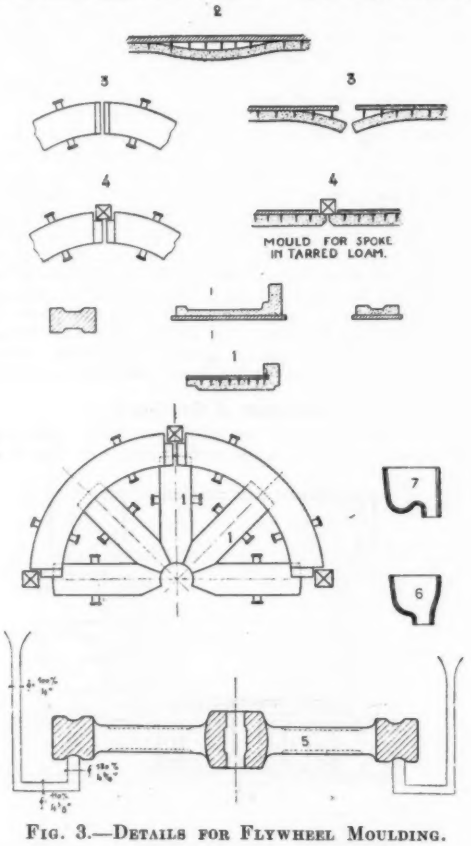


FIG. 3.—DETAILS FOR FLYWHEEL MOULDING.

and the hub. These slabs are worked up in a very short time (Fig. 3, No. 1). After remaining a night in the drying stove, the first arm is lifted from its pattern, and the second is made, and so on. By this process two moulders and one coremaker can easily finish a 20-ton flywheel in three weeks and a 30-ton flywheel in four weeks, the comparison being:—

Old Method.—Three moulders and a labourer for 30 days of 10 hours, say, 300 hours × 4 = 1,200 hours, plus 80 hours for the cores = 1,280 hours.

New Method.—Two moulders for three weeks = 2 × 3 × 48 = 288 hours; one labourer, 80 hours; one coremaker, 120 hours; making a total of 488 hours. Taking 500 hours as a round figure, the ratio is 1: 2.4.

Chief Difficulties Encountered.

The periphery finished, the assembling of the rim and arm slabs was proceeded with, afterwards the mould was dried by portable hot-air mould driers. As a result, the top part of the mould (the parts in loam) absorbed a large part of the moisture from the lower portion and became spongy; some of the thin layers of loam buckled and formed air pockets (Fig. 3, No. 2), and were washed away by the metal; the blacking did not stick to the spongy surface, and thus the casting had a rough and scabbed appearance.

A second trouble occurred at the joints of the loam slabs, often caused by slow pouring. The expansion of the sand on the periphery of the wheel, due to radiation from the metal, caused crushing at the joints and formed gross defects at these points. It often happened also that the slabs, half an hour after pouring, having absorbed the maximum amount of heat from the casting and expanding several inches, broke the sand at the joints still further, which forced its way into the pasty metal and thus formed a large cavity at each joint (Fig. 3, No. 3). To cure these serious defects, the following method was employed:—(1) It is sufficient to dry the bottom part mould in the early stages, perhaps the first day, or by the labourers of the night gang, covering the rim and arms with sheet iron; after blowing through hot air for seven or eight hours, the moisture is driven off, the sheets removed, and the assembling of the rim and arm slabs proceeded with; the mould drier is again used for about the same period; the loam part does not then receive the moisture from the sand. (2) The edges of the slabs at the joints are bevelled, wedges are driven between them, iron to iron, and their expansion has then no effect on the joint. In addition, the speed of pouring, as we shall see later, only allows a slight expansion of the sand before the mould is completely filled (Fig. 3, No. 4).

Pouring.

The casting is bottom run at the rim (see Sketch 5) and with an expanding ingate, which causes the metal to flow easily on the sand of the runner. To pour quickly at constant pressure through a constant area runner causes sand washing, the speed of the metal increases heat radiation, burns the facing, and gives rise to scabs, etc.

It is well established that it is possible to pour a flywheel by using a system of expanding runners, or in other words, a reduced pressure system (Fig. 3, No. 5). The author believes that a 20-ton flywheel ought to be poured in one minute, and he has often poured flywheels of 10, 12, and 15 tons in 44 to 50 secs.

It is important that the upper of the mould be subjected to radiation from the liquid metal for as short a time as possible. The metal is poured from two ladles holding 10 to 15 or 20 tons according to the weight of the casting. The metal is decanted from one ladle to the other to ensure a homogeneous mixture, otherwise, as already mentioned, there is a possibility of unequal stresses being set up during contraction which may cause cracks, particularly in the arms.

In order to enable a large body of metal to be emptied into the reduced pressure runners, funnel-shaped runner bushes are employed (Fig. 3, No. 6), as skimming bushes similar to No. 7 will not take the metal quickly enough.

Loam Moulding a Sugar Cane Calender.

Large calenders (Fig. 4) of 8½ ft. dia. × 6½ ft. to 9½ ft. high and of generally thin section (not more than 1 in.) are castings which require great care to ensure success. It is impossible to guarantee success with a sand mould, owing to the friable nature of the sand, and especially of the large surface of the mould, perhaps 22 to 27 sq. yards. In addition, the great height and the speed of pouring cause disintegration of the sand, the metal scouring the walls of the mould strongly as it enters. Loam moulding, therefore, offers a more certain chance of success.

Mould faces in loam are not disintegrated by the scouring action of the flowing metal, and they are not burnt so quickly when Mixture No. 2 loam containing coke, which has a minimum expansion, is used.

This sand is very refractory (notwithstanding its high calcination loss of 20 per cent.), it has a very hard surface, very open at a thickness of ¼ in. to ⅜ in., and more so at a thickness of ⅛ in., which is the thickness that should be used.

The gases easily escape, and it is unusual for the sand to wash in the runner, even in the case of high pressures, large bodies of metal and great heights. The sand withstands the force of the metal without crumbling.

For this kind of casting, loam moulding is much quicker and, as a general rule, may be taken as little more than 60 per cent. of the time occupied for the same mould in sand.

Two essential features need to be observed:—

(1) The cast-iron rings in the core (Fig. 4, No. 5) must be in one piece and not cut on one side for expansion. These rings made in one piece greatly strengthen the core, but in order to permit of the contraction of the casting (2) they must be faced with straw rope (Fig. 4, No. 6). This is absolutely necessary, otherwise the resistance to contraction would crack the casting, whereas when the straw is burnt a space is formed between the ring and

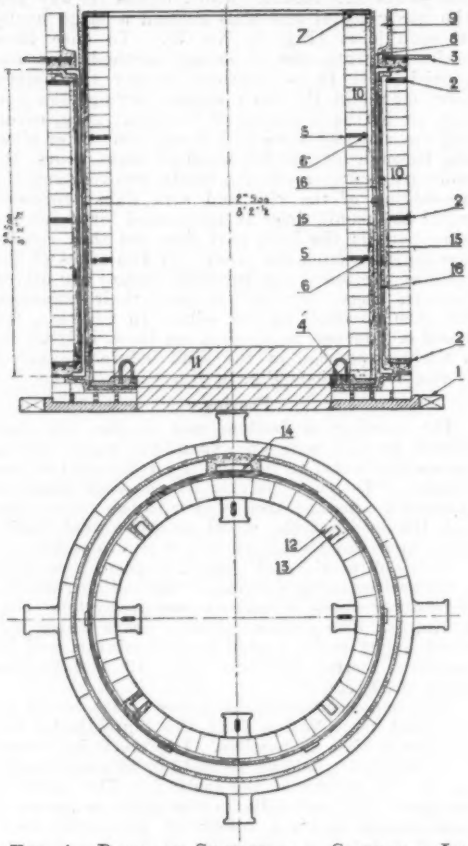


FIG. 4.—PLAN AND SECTION OF A CALLENDER LOAM MOULD.

the outer layer of sand which permits free contraction.

Pouring the Calender.

The casting is poured from the top by means of small ingates, well separated (Fig. 4, No. 8), the metal being poured into a trough (No. 9). It is necessary to keep the runner-bush full and to pour as hot as possible, as the ingates (No. 8) should not be larger than 3-16 in. × 2½ in.

The core should be rammed hard with a pneumatic rammer, in the lower portion, to a height of about 20 in.; in order to avoid run out at the bottom joint a weight of 5 to 7 tons, with a fairly large area, is placed on the layer of sand rammed at the bottom, the rest of the core being left free. This makes an appreciable economy in labour. The escape of the gases takes place with great rapidity, which, in the case of thin castings, is a factor of primary importance.

In regard to the core the cast-iron rings inserted in it make it very resistant to the pressure of the metal. Three hours after pouring the sand layer (No. 11, Fig. 4) is removed, and the rings (No. 5) are rapped with a light hammer so as to detach from the layer of sand; five hours after pouring a groove is cut from the top to bottom of the casting in the loam bricks (No. 12) inserted for the purpose in the core. This operation reduces the total core thickness by half (No. 13), and gives elasticity to the core, allowing the casting to contract naturally without strain.

Special Recommendation.

The bottom ring (No. 4, Fig. 4) should be entirely contained in the print, at least 2 in. below the casting, so as not to interfere with the contraction of the latter.

It is imperative that the core and the mould be bolted to the baseplate, or otherwise heavily weighted, as the height from which the metal falls produces a serious head of pressure, enabling the metal to penetrate into the base, forming a flash, which may lift the core. The outside of the mould must be rammed as hard as possible, otherwise there is danger of bursting.

In Fig. 4, 1 is a base ring; 2 covering ring for the collar and reinforcement ring; 3 cover ring and support for pouring trough; 4 bottom ring for the core; 5 intermediate rings to reinforce the core; 6 straw ropes; 7 top ring for clamping the core; 8 runners; 9 pouring trough; 10 red bricks; 11 layer of sand; 12 loam bricks; 13 grooves cut in the loam bricks three hours after pouring; 14 feeding head or riser; 15 layer of loam (open grain); and 16 layer of sand with coke.

The time required for moulding this casting is 70 hrs. for one moulder and an assistant.

Moulding a Large Marine Engine Cylinder.

Moulding a large cylinder in loam has for its object production of casting of regular thickness and free from defects. By moulding in loam it is possible to arrange the joints of the mould in all the necessary planes, so that assembling and coring up can be carried out with the certainty of correct thicknesses being attained, the various cores being secured by iron wires or bolts. In a loam mould (Fig. 5) holes can be cut for certain cores, such as for the pipes (No. 8, Fig. 5), of which the core can be inserted from the outside of the mould so as to unite with the exhaust core, fixing it by a joint and a wedge on the outside, which takes a bearing on one of the mould grids.

The cylinder shown here would be jointed in the following manner, so as to secure the maximum facility for locating the cores and the parts of the mould, adjusting the thicknesses and fixing the whole by means of galvanised hooks, wires, etc., to the interior and the exterior of the mould.

Contraction of the Mould.

The mould would be built up on a cast-iron baseplate (No. 1) made very solid, not less than

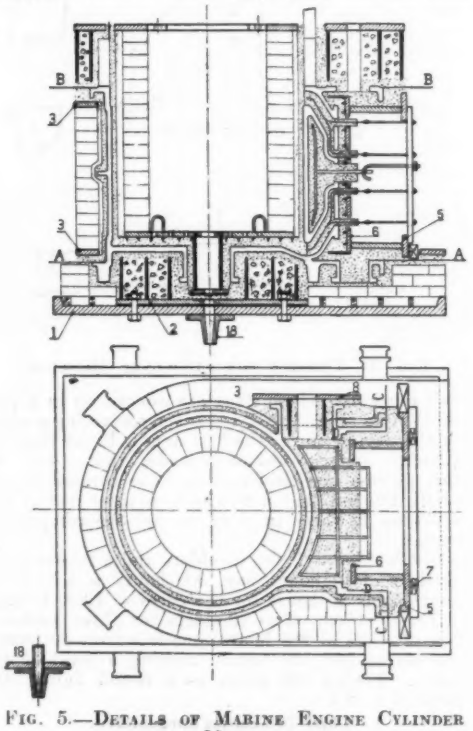


FIG. 5.—DETAILS OF MARINE ENGINE CYLINDER MOULD.

2½ in. to 3½ in. thick, and with a rim on the outer edge. A case-iron grid (No. 2) would be attached to the base, having wrought- or cast-iron pins cast into it, this grid serving to hold all those portions of the loam and sand which project on account of pipes, bosses, etc. This part of the grid would have the interior filled with coke, so as to form a vent for the gases. Care must be taken to see that there is at least 2½ in. of loam, in addition to ¾ in. layer of sand. This part of the mould is

swept up by means of a conical pointed spindle, the bush of which is fixed on to the base (No. 18) at the joint shown by line A. A.

The body of the mould is built up of red bricks and loam bricks on a frame (No. 3), which carries the main body of the mould. This main body forms, following the lines B. B. and C. C., a joint with the top part covering the steam-chest, the outer flange of the steam-chest and the top flange of the cylinder. A collar of the same shape as that shown at No. 3, but thinner, is placed underneath the top flange so as to strengthen the mould.

The riser part is made on a grid with pins (No. 4). The steam chest is then formed along the lines D. D. This part of the mould is made to pattern, and after being marked out and filed to fit the parts of the mould above and below, the thickness of sand left by the pattern is placed in position. The steam chest is made on a plate (No 5) fitted with a grid (No. 6). The inlet and exhaust port cores are made in false moulds of loam (tarred when there are many cores to be made). All these parts of the mould are made separately, so that the work can be quickly carried out.

Coring Up and Preparing the Runner.

The baseplate is placed level and in a position which allows free access all round. The body of the cylinder mould is placed on the baseplate exactly central, and checked to the datum lines which are marked out when these two parts were tried together before blacking up.

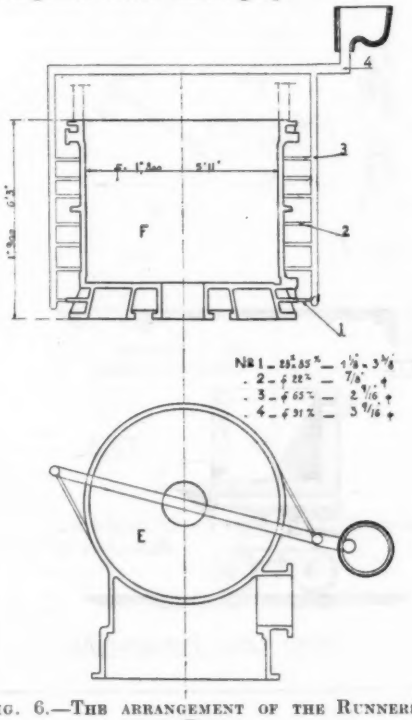


FIG. 6.—THE ARRANGEMENT OF THE RUNNERS AND RISERS.

The inlet and exhaust port cores are fitted in the steam chest core, and after making sure that they are correctly located they are fixed by means of small bolts (as shown in the illustration). All being fixed, this part is removed by two lugs in the coreplate (No. 5), and we thus have the steam chest, as shown in the vertical section drawing. There remains little difficulty in fixing this securely in the body of the mould.

Having made certain that all is in place, a wedge (No. 7) is inserted between the coreplate and the lower mould grid. By this process it is possible to examine the position of each part of the mould, and to correct it, if necessary. The barrel core is then introduced, and it is easily seen if it makes a good joint with the port cores, etc.

There only remains the header, which is placed in position last of all, after having wedged and bolted up all the parts of the mould. It is necessary to replace the closed mould in the stove, so as to dry the joints which have been luted with wet loam.

Pouring the Casting.

The method of pouring is of primary importance for the success of castings of great mass and varying thicknesses. Also, for larger cylinders, the author favours pouring from a single ladle, to ensure homogeneous metal, but through a number of small ingates ½ in. to ¾ in. dia. and in number 12 to 14 for a cylinder of 12 tons weight.

The runners are attached tangentially on either side of the casting (as shown in Fig. 6). They are calculated so as to ensure rapid running (10 secs. per ton). One of the most important factors is to secure the flow of the greatest volume of metal into the casting in the shortest time, but at low pressure.

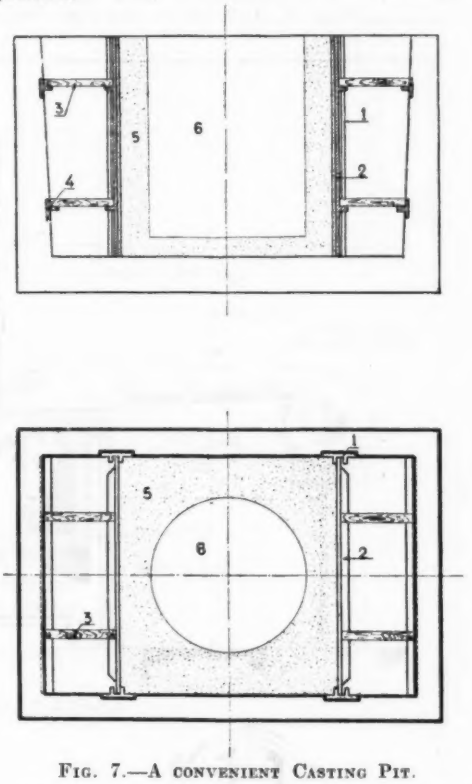


FIG. 7.—A CONVENIENT CASTING PIT.

A cored casting should not be subjected to metal pressure, as the metal circulating under these conditions in the mould will attack the mould faces, whereas if the casting is poured at reduced pressure even a large quantity of metal will flow easily over the mould surface without burning and erosion. In order to reduce pressure, the area of the main runner (Fig. 6, F., No. 4) should be 30 per cent. less than the total area of runners 1 and 2; for example, the area of runners 1 and 2 is 9,360 sq. mm., less 30 per cent., which equals 6,560, and this corresponds to a main runner 91 mm. dia.

This method has always given the best results, and the author uses it for all castings above ½ ton The author considers the double tangential runners the best for cylinders, as the circular motion of the metal floats up into the riser all sand, slag, scum, etc. In the bore of a cylinder the metal surrounding the barrel core, if not enlivened by a circular movement, brings about inequalities of temperature, which may give rise to cold shots; sand and slag may stick to the core by the pressure at the surface of the metal, whereas by giving the metal a circular movement it washes the core and mould, and one is certain to get clean metal, which will give a perfect bore.

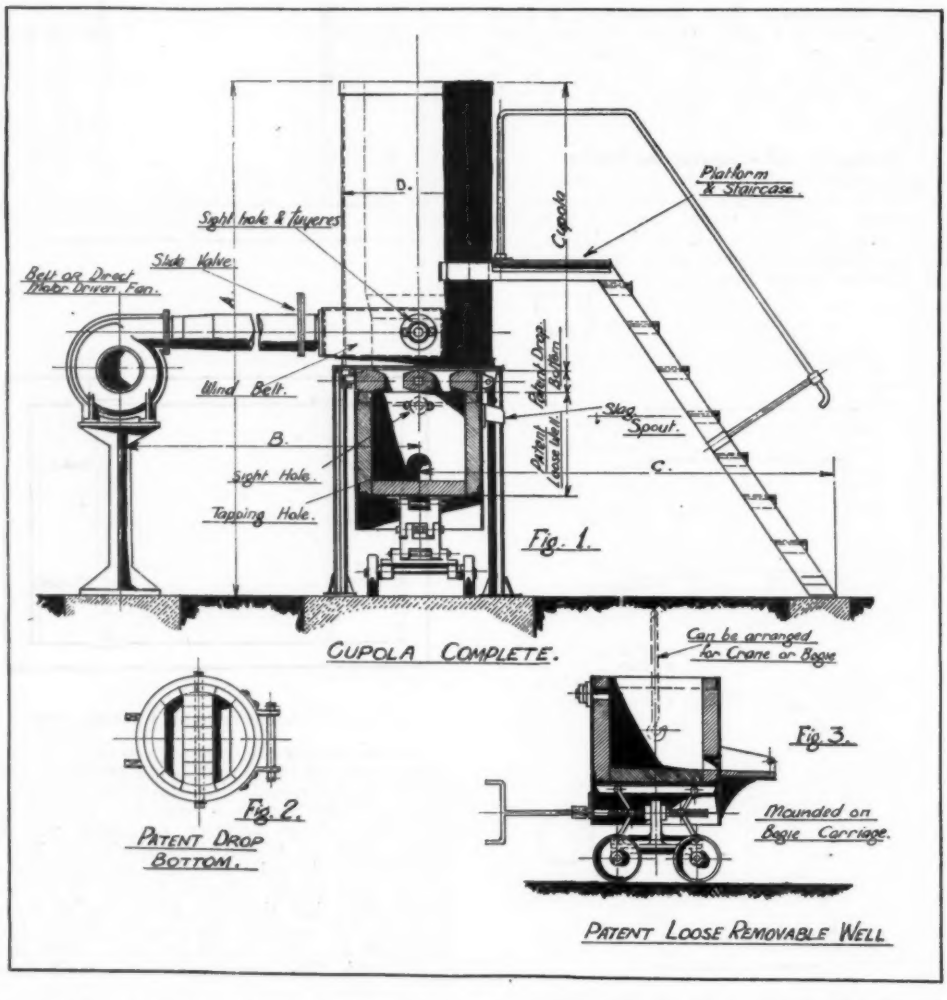
A Convenient Casting Pit.

Fig. 7 represents a pit furnished with plates supported with props. By this system, as soon as the casting is poured, and before the sand hardens, the plates (No. 2) can be withdrawn and the sand (No. 5) may be easily removed, as can the casting. In Fig. 7, No. 1 represents the cast-iron slides; No. 2, cast-iron plates; No. 3, wooden props; No. 4, brackets; No. 5, rammed sand; and No 6, the mould to be poured.

A New Type of Small Cupola.

We are indebted to Messrs. E. Roper and Co., of Keighley, for particulars of a new design of emergency cupola which they have recently placed upon the market. This small type of cupola is an adaptation of the firm's removable well principle.

Fig. 1 illustrates the cupola, with a patent drop bottom and loose-removable well in position, whilst Fig. 2 shows a plan view of the drop bottom only, and Fig. 3 depicts the loose well mounter on an adjustable wheeled carriage, and removed from the cupola. The drop bottom of the cupola, as will be seen in Fig. 1, is immediately below the tuyeres, thus eliminating the bulk of the bed coke, which is claimed to result in an important economy in fuel, associated with a lower sulphur content.



The removable well is mounted immediately below the drop bottom, and becomes a receiver attached in such close proximity to the melting zone that a high temperature is maintained in it. Further, as no coke is present in the well, the whole area is available for storing metal, and a substantial amount can be carried.

When a large casting is to be poured the whole of the melt can be carried to the mould. A better mixing of the metal is thus assured. In such a case the well is lowered from the furnace on the carriage, and taken to the mould, and tapped out there, the well being used as a bogie ladle.

Continuous working.—The operation described above can be continued all the day if desired, the cupola emptying each time into the well and being removed, tapped out, as the drop bottom is not disturbed in any way by the removal of the well.

The well, when removed from the cupola, has an open top, and therefore could not be better for cleaning and making up the tapping hole; no fettling hole is required, and the hearth being a permanent ganister one, the cleaning time is reduced to a minimum.

The Cupola quickly in operation.—The patent drop-bottom being a steel and brick grid with slot holes right across under the bed coke (through which it is lit) gives ample access for air immediately under the bed coke, which is in consequence quickly burnt through; the well or receiver not being put into place until the bed coke is burnt through.

THE IMPORTS of foreign ore at the Senhouse Dock, Maryport, for the week ending June 9 amounted to 3,500 tons. The imports of foreign ore at the Workington dock for the same week amounted to 2,450 tons.

IN connection with the deal between B.S.T., Limited, and Platt Brothers & Company, Limited, of Oldham, a circular has now been issued to the shareholders of the latter company calling a meeting to consider proposals to increase the capital of the company by the capitalisation of part of the reserve fund. The proposal is that the capital be increased to £3,710,160 by the creation of 618,360 7 per cent. cumulative preference shares. The new shares will rank for dividend next in order after the 1,236,720 existing 4½ per cent. cumulative preference shares and in priority to the ordinary shares. If the resolutions are carried the capital of the company will then consist of 1,236,720 4½ per cent. cumulative preference shares of £1 each, fully paid, 618,360 7 per cent. cumulative preference shares of £1 each, fully paid, and 1,855,080 ordinary shares of £1 each, fully paid. The new shares will be distributed to the ordinary shareholders *pro rata* to their holdings on July 6. More than the necessary 75 per cent. of the shareholders have approved the directors' recommendation that the £1 ordinary shares of the company (apart from those held by the Hartford Trust) be sold to the British Shareholders' Trust, Limited, for 45s. per share, after the payment of a 20 per cent. dividend this month.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Cast Iron and its Chemical Composition.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Mr. Smalley answers my criticism on May 16, by his letter to you dated May 31, and I conclude my discussion with the following remarks.

I said that "*few of us had noticed that the American casting was superior to our own.*" Mr. Smalley chooses to describe this as "*biting sarcasm,*" whereas in truth it was intended to be a plain statement of what I believe to be a plain fact, both scientifically and commercially.

Mr. Smalley also chooses to say that I "*sneer*" at the control of the chemical composition of cupola-melted cast iron, whereas, in truth, I am well known to be a believer in it. The point of my comment, which Mr. Smalley has missed, referred to his claim to have made "*thousands of tons of castings containing* 3.10 *to* 3.15 *per cent. total carbon,* 9.19 *to* 0.11 *per cent. sulphur, and* 0.65 *per cent. manganese.* I said this was "*surely a record of controlled compositions.*" Moreover, I have no hesitation whatsoever in again saying it.

In reply to a problem I put to him, he asks what temperature I want the iron to be run into cold water. My problem stated that the metal should be melted in a cupola, caught in a receiver, and tapped thence into a column of iced water. The temperature of the tapped metal cannot be specified, and must be ascertained in the flow of metal just before it enters the water.

I asked Mr. Smalley if he had taken a correspondence course on semi-steel. This is his reply: "*Mr. Young has the advantage of me here as I assume from the tone of his letter he has followed such a course and it has failed him. Mr. Young should not condemn or even gibe at the use of steel in the cupola; there are always two sides to every question. . . . . I ask Mr. Young to try it again. He might have better success.*" Apart from the question as to which party is committing the offence of "gibing," I may put it to Mr. Smalley that he has hopelessly deceived himself for, although I have never seen one of these correspondence courses, I frequently use steel in the cupola-mixtures, and have done so for many years. Moreover I should be glad to study one of these courses if I could obtain it at no more than the cost of a good scientific book.

Mr. Smalley makes a departure in bringing in the name and position of my head-assistant, Mr. Gresty . . . . one cannot maintain an impersonal attitude when commenting upon this so I will not comment, but I may mention I am positive that no assistant of mine would suggest that "*the temperature of molten cast iron in the cupola is* 2,200 *deg. C.*" This is another statement which we cannot accept on Mr. Smalley's bare word.

In my original letter I said I found the greatest difficulty in appreciating the analyses given by Mr. Smalley and pointed out the very great and real difficulties of the analysis of cast iron. . . . Mr. Smalley's reply to this does not meet the case. I still say that I am unable to appreciate many of Mr. Smalley's figures relating to compositions: my experience tells me that they are in need of proof.

Finally, I may draw attention to yet another statement for which we cannot accept Mr. Smalley's word. He says: "*Mr. Young openly admits he is unable to dispute the contents of the paper, etc.*" As a matter of truth I said as follows: "*I have not contradicted him upon any point.*"

I dispute practically the whole of his paper until he brings convincing proofs of the reliability of the results showing how many times they were repeated and the full conditions of the experiments. Personally I know so little about cast iron that I am very ready to accept anything, however revolutionary to our present ideas, as soon as proofs are forthcoming.

In my first letter I said "*I have little doubt but that he has touched upon the truth in several instances . . . therefore let him linger long enough to prove some of these things to us.*"

Mr. Smalley appears to be more eager to criticise me than to prove his work, and therefore this correspondence will, if it has not already done so, become fruitless. Perhaps, as Mr. Smalley says: "*I cannot retain either politeness or judgment when my prejudices are being disturbed.*" It is a pretty safe conclusion to come to, but has Mr. Smalley disturbed any of my prejudices?

For my part this correspondence ends here.—I am, Sir, yours etc.,

HORACE J. YOUNG, F.I.C.

Laboratory,
Northumberland Engine Works,
Wallsend-on-Tyne,
June 16, 1922.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—*Re* Mr. Smalley's reply in THE FOUNDRY TRADE JOURNAL, dated May 8, to Mr. H. J. Young's criticism of his recent Paper, I notice the following:—"Mr. Gresty, Mr. Young's assistant, writes suggesting the temperature of molten cast iron in the cupola is 2,200 deg. C."

I fail to see any justification for Mr. Smalley's use of my name in a public correspondence to which I am not a party, and it is obviously used merely because I happen to be Mr. Young's assistant. Apart from this altogether, however, the above statement is an apparently deliberate misrepresentation of my written contribution to the official and as yet unpublished discussion on the Paper. The actual words I used were . . . . "the theory depends entirely on the maximum temperature attained by the metal in the cupola which in turn partly depends on the temperature reached by the cupola. The figure quoted, namely, 1480 deg. C., seems very low, and he (the writer) would like to know whether this temperature is one found by actual measurement or merely assumed. Other investigators have given figures as high as 2,200 deg. C."

It is only necessary to compare what I *did write* with what Mr. Smalley *says I wrote* to see that the latter is in no way a correct statement. In fairness to myself and to Mr. Young I trust you will publish this letter.—Yours etc.,

COLIN GRESTY.

Laboratory,
Northumberland Engine Works,
Wallsend-on-Tyne,
June 9, 1922.

British Trade Ship.

In view of recent announcements of a projected voyage round the world by the steamship "Orontes," renamed "British Trade," confusion has arisen between this voyage and that arranged for another vessel under the auspices of British Trade Ship, Limited, of which Earl Grey is chairman.

The "Orontes," or "British Trade," has no connection whatever with British Trade Ship, Limited, whose proposal is to build a special ship for the purpose of an exhibition and send her round the world in 1924.

The intended voyage of the "Orontes" follows very closely the itinerary sketched out for the British Trade Ship, but Earl Grey and his co-directors of British Trade Ship, Limited, desire to make it quite clear to intending exhibitors on the "Orontes" (or "British Trade") that British Trade Ship, Limited, is in no way responsible for any arrangements in connection with the "Orontes" voyage.

Publications, etc., Received.

HEAT TREATMENT BULLETIN, No. 30. "The Heat Treatment of Alloy Steels." Messrs. Automatic & Electric Furnaces, Limited, 281-283, Gray's Inn Road, London, W.C.1.

"THE COMMERCIAL BULLETIN," published by the Department of Commerce and Industry of the Government of Palestine. Annal subscription, P.T. 65 (= 13s. 4d.), post free, payable either to the Director, Department of Commerce and Industry, Lazarist Hospice, Jerusalem, P.O.B. 590, or to the Crown Agents for the Colonies, 4, Millbank, London, S.W.1. The price for individual copies is 7d. post free.

MESSRS. CONSETT IRON COMPANY, LIMITED.—Brochure showing fractures and analyses of their various brands of pig-iron.

Trade Talk.

W. H. SUGDEN & COMPANY, LIMITED, have established new works at Glenny Road, Barking, Essex.

J. & A. McMORLAND, iron ore, iron and steel merchants, etc., have removed from 33a, Gordon Street, to 40, St. Enoch Square, Glasgow.

JOHN BROWN & COMPANY, LIMITED, Clydebank, have received instructions from the Cunard Company to resume work on one of two liners which they have on hand.

BALDWINS, LIMITED, have removed their London office from 3, St. Helens Place, E.C.3, to G.P.O. Box 286, Baldwin House, 67-71, Queen Victoria Street, E.C.4.

THE AVERAGE price of West Coast hematite mixed numbers for May has been ascertained as £4 19s. 5d. per ton, compared with £4 18s. 6d. in the previous month.

THE directors of the Sheffield Steel Products, Limited, have issued a denial to rumours to the effect that the whole of their works are closing down indefinitely.

MR. W. M. SELVEY, consulting engineer, Independent Buildings, Sheffield, has opened a London office at 23, Old Queen Street, Westminster, S.W. Mr. Selby will reside in London at the end of the month.

ALFRED HERBERT, LIMITED, Coventry, have opened their gear-cutting department for outside work. Mr. F. W. Shaw, recently works manager to David Brown & Sons (Huddersfield), Limited, is in charge.

MR. J. T. BANNER has severed his connection at 31, Queen Street, Wolverhampton, and is now carrying on business at the Woodlands, Catholic Lane, Sedgley, Staffs, as an iron, steel and mineral merchant.

FAMA (SOCIETE ANONYME), 8, rue Blanche, Paris, have acquired the exclusive licence to construct and instal Riley stokers in Great Britain and its Dominions, as well as France, and a British company will shortly be constituted by them. The present London offices are at 64, Mark Lane, E.C.3.

LICENCES under the Non-Ferrous Metal Industry Act, 1918, have been granted to the China & Japan Trading Company, Limited, 5, East India Avenue, London, E.C.3; Kief & Brother, Limited, 137, West George Street, Glasgow; and A. G. Paterson & Company, 166, Buchanan Street, Glasgow.

THE contract for the steel gates for the entrance of Palmers' Dry Dock at Swansea, now in course of construction, has been placed with the Engine-Works Department of Sir W. G. Armstrong, Whitworth & Company, Limited. The contract includes, besides the gates, the hydraulic gate-operating machinery and the hydraulic capstans forming the equipment of the entrance.

THE average price of West Coast hematite pig-iron during May having increased 11d. per ton the wages of blast-furnacemen in Cumberland and North Lancashire will be advanced 1¼ per cent. (the first increase since 1920) to 36¾ per cent. above the base rates from the commencement of the second full pay in June. The scale percentage on bonus earnings will be 74¼ per cent. and 69¼ per cent. for the Workington and Furness areas respectively.

THE pig-iron ascertainment for the Cumberland district for May shows a rise in price of 11d. per ton. The rise, however, is so small that no addition will be made to wages of iron-ore miners in West Cumberland this month. The wages will, therefore, be the same as those for the previous month, viz.: Underground miners' bargains, 9s. 11d. per shift; miners' minimum, 7s. 3d. per shift; first-class leading labourers, 6s. 4d. per shift; other underground labourers, no change; trailers according to their respective category; boys under sixteen years of age, no change; surface workers, with the exception of winding enginemen and boys under sixteen years of age, no change; boys under sixteen years of age, no change; winding enginemen, 8s. 8d. per shift; joiners, 9s. 1d. per shift, plus 6d. for tool allowance; chargemen, mineral shot borers, 9s. 7d. per shift, plus 3d. per foot; blacksmiths, 9s. 1d. per shift.

AN AGREEMENT between the Cumberland and North Lancashire pig-iron makers and blast-furnacemen has been concluded, under which the wages of the men will continue to be regulated by the 1919 sliding scale agreement until the middle of October of this year. The agreement means that there will be no further reduction below 35½ per cent. (corresponding to £4 18s. 6d. per ton for iron) on standard rates in the wages of the blast-furnacemen until the commencement of the second full pay day in October, 1922, no matter what the price of iron may be. If the ascertained price gives an advance in wages the blast-furnacemen will be paid the advance. The question of fixing new rates of wages for the industry is postponed until October, 1922, when both sides hope that stable conditions will prevail in the iron trade. The agreement prevents any likelihood of a stoppage of work taking place during a critical period in the industry.

Company News.

Pather Iron & Steel Company, Limited.—Dividend for 10 months to March 31, 1s. per share, less tax; carry forward, £8,337.

Richardsons, Westgarth & Company, Limited.—Two years' dividend on preference shares; ordinary dividend, 8 per cent., less tax.

James Keith & Blackman Company, Limited. — Net profit, £20,481; brought forward, £12,575; ordinary dividend, 7½ per cent., free of tax; carried forward, £15,944.

H. Haydon & Company, Limited.—Capital £1,500. Electrical engineers, etc. Directors: H. H. Haydon (managing director) and R. Dunn. Registered office: 3, Welford Road, Leicester.

Arthur R. H. Maxted, Limited.—Capital £4,000 in £1 shares. Engineers. Directors: A. R. H. Maxted, W. E. Mullen, and B. Maxted. Registered office: 7, Hardwidge Street, Bermondsey, S.E.

Irvine & Dyer, Limited. — Capital £10,000 in £1 shares, to acquire the business of ironfounders, engineers, etc., carried on by Irvine & Hunter. Directors: J. W. Irvine and A. O. Dyer. Registered office: Campbell Street, Hebburn-on-Tyne, Durham.

Ransomes, Sims & Jefferies, Limited.—Profit, allowing for depreciation, bad and doubtful debts, and interest on debentures, £3,997; dividend on preference to June 30, 1921, £2,750; brought forward, £40,811; available, £42,058; no dividend on ordinary for year, or final preference.

Acme Steel & Foundry Company, Limited.—Capital £25,000 in 10,000 cumulative preference shares of £1 and 15,000 ordinary of £1. Private company. Directors: Robert Waddell, John R. Waddell, and James Reid Rumbold. Registered office: Gartocher Road, Shettleston, Glasgow.

Isaac Hill & Son, Limited.—Capital £20,000 in £1 shares, to take over the business of engineers, founders, etc., carried on by Isaac Hill & Son. Directors: J. Hill (chairman), Mrs. E. Hill, D. M. J. Hill, A. Morley, and W. E. Bradley. Secretary: A. Moorley. Registered office: St. George's Works, Wood's Lane, Derby.

Ruston & Hornsby, Limited.—Gross profit, £101,637; depreciation, £55,952; interest on debentures, £25,500; net profit, £20,185; brought forward, £43,920; available £64,105; dividends on preference to July 1, 1921, £5,875; transferred from reserve, £100,000; dividend on preference shares and ordinary dividend for year passed; carried forward, £158,230.

Deaths.

MR. ALFRED BATES, works manager for Bailey, Pegg & Company, Limited, ironfounders and merchants, of Brierley Hill, South Staffs, died recently, aged fifty-three.

MR. J. BAIN, for over thirty years superintending engineer of the Cunard Steamship Company, died recently. The deceased, who was born in 1841, served his apprenticeship under Sir Robert Napier. After a short training he served as a sea-going engineer in the Cunard White Star liners, and in 1875 he became a Lloyd's surveyor. After being with Lloyd's for ten years he again joined the Cunard Line as superintending engineer, and was responsible for building a series of ships which are historical on account of their successive development in speed, and in the principles of propelling machinery, extending to the "Mauretania." Mr. Bain retired a few years ago.

Personal.

THE late Mr. J. Green, founder of John Green, Limited, anchor and cable manufacturers, Old Hill, left £28,526, with net personalty £18,030.

MR. G. W. COSBY, northern district office manager of the Westinghouse Morse Chain Company, Limited, has joined Jenks Bros., Limited, of Wolverhampton.

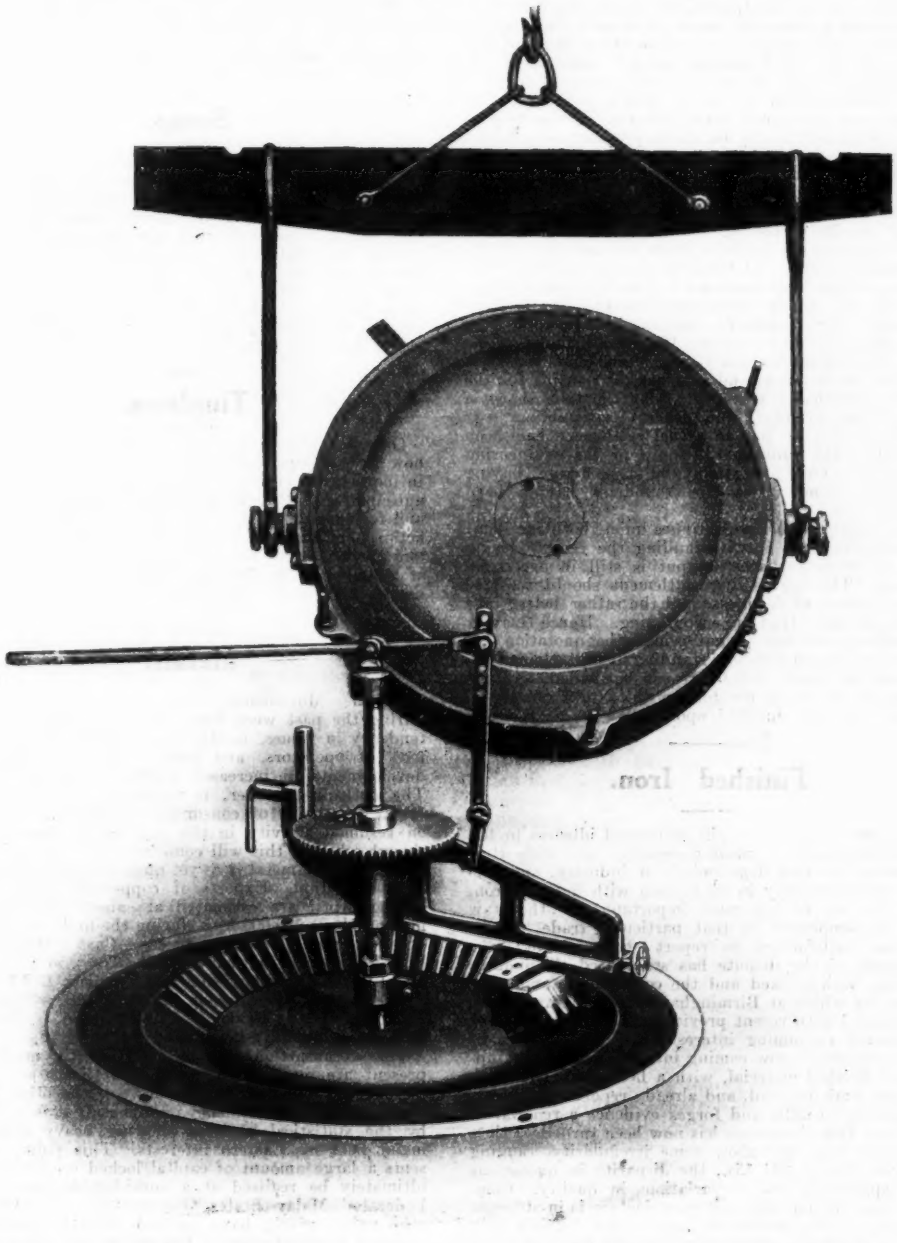
MR. R. HARDY, a director of R. Hardy & Company, Limited, iron and mineral merchants, Royal Metal Exchange, Swansea, died recently, aged sixty-six. The deceased gentleman commenced business nearly 35 years ago.

MR. H. H. BURNESS, who for the past year has been acting as assistant lecturer in civil engineering in Victoria University, Manchester, has been appointed Lecturer in Civil Engineering at the University College of Swansea.

MR. J. CUNNINGHAM, divisional engineer, Great Western Railway, at Neath, has been appointed the divisional engineer for the Cardiff Valleys Division. In consequence of this, Mr. R. Carpmael, at present divisional engineer at Shrewsbury, has been appointed to a similar position at Neath.

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.



THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

JAMES EVANS & CO., BRITANNIA WORKS,
(MANCHESTER), LIMITED,
BLACKFRIARS, MANCHESTER.

IRON AND STEEL MARKETS.

Pig-iron.

With a steadily improving outlook, as far as labour questions are involved, prospects in the pig-iron trade have taken a distinctly more favourable turn during the past week, though it would be idle to pretend that any great volume of business has yet materialised. In the Midlands, some accumulations of stocks at furnaces have resulted from the recent slump in buying, but makers now anticipate little difficulty in disposing of the surplus, and are by no means pressing sales, which are still much on a hand-to-mouth scale, very few transactions being reported beyond prompt deliveries. With regard to the prices of Derbyshire and Northamptonshire pig, recent quotations are firmly maintained, smelters showing little disposition to grant concessions except perhaps where an exceptional tonnage is concerned. At Glasgow pig-iron producers are getting rather better prices for foundry qualities than was the case a few weeks ago, but business is slow. Hematite has nominally advanced from 105s. to 107s. 6d., delivered locally. Work on a limited scale is to be resumed at the Glengarnock blast furnaces. Business in the Cleveland iron market remains for the present practically stationary, but the tone shows a distinct improvement, and general satisfaction was expressed that at last an actual settlement had been effected in the prolonged dispute in the engineering industry. This has stimulated a moderate buying movement, some orders for foundries having been placed.

The hematite market continues quiet, both for home and export, and, notwithstanding the recent closing down of three furnaces, output is still in excess of demand. The engineering settlement should set free a good volume of business, and the rather better outlook in the steel trade is encouraging. Hence there is no tendency further to cut prices, the quotation for East Coast mixed numbers standing at 95s., though, as reported last week, this figure can be shaded, and the full premium of 1s. per ton on the No. 1 quality is not in every case insisted upon.

Finished Iron.

The adverse effects of the prolonged idleness in the engineering branches must necessarily take some time to remove in other departments of industry, and perhaps more especially in connection with finished iron, which is one of the most important of the raw materials employed in that particular trade. It is, however, satisfactory to report that already the settlement of the dispute has stimulated the inquiry for bars, both marked and the commoner brands, the market for which at Birmingham this week was active as compared with recent previous experiences. One of the largest consuming interests, the manufacture of motor vehicles, is now coming into the market for supplies of finished material, with a heavy weight of unexecuted work in hand, and already reports of increasing activity as mills and forges evidence a renewal of confidence that the corner has now been turned. Prices for crown bars still show some irregularity, ranging from £10 15s. to £11 15s., the disparity in quotations being apparently due to variations in quality. Commoner iron for nut and bolt manufacture is in stronger demand at £10, while the inquiry for marked bars shows a gratifying improvement at £13 10s. (net f.o.t. works). Business generally at present is confined to orders for prompt deliveries, manufacturers hesitating to accept commitments over extended periods owing to uncertainty as to the future course of prices and costs of production.

Steel.

Business in most sections of the steel industry has been marked during the past week by a much more optimistic tone, and although buying is still on the usual restricted scale, the tendency of home and foreign inquiries is distinctly encouraging to hopes of an early renewal of active buying. In the market for semi-products, for example, the demand for basic billets is already improved. Lincolnshire makers, quoting at about £7 7s. 6d. for soft and £8 15s. for hard, delivered, are in sharp competition with local makers at £7 15s. and £9 5s. respectively. Acid billets do not show any very decided improvement at the moment, but it is expected that a week or two will make a distinct difference. Steel manufacturers and others have a fair amount of business on hand, the accumulation of the past six weeks or so. Most of the orders are on the small side, but in the main they amount to a substantial tonnage. At Sheffield it is reported that orders to build 400 all-steel coaches for Indian railways have been received by Messrs. Cammell, Laird's. The coaches will be built at Nottingham, but the raw materials will be made at Sheffield. Bessemers have also received large orders for tramcar tyres, while various other firms are benefiting by an obviously increasing demand. Forge and rolling mills in the city and district are now back to a five-day week, and other works have also increased the number of working days per week.

Scrap.

Reports from the various centres of trade favour an impression that a revival of active conditions may shortly be expected, and in some cases consumers have now resumed accepting deliveries of metal on standing contracts. The following are approximate prices current at Middlesbrough, all delivered works:—Heavy steel melting scrap, 62s.; cast-iron machinery scrap, 80s.; ordinary heavy cast-iron, 75s.; steel turnings, 45s.; c.i borings, 45s.; heavy w.i. piling scrap, 62s. 6d.; bushelling scrap, 62s. 6d.; heavy forge iron scrap, 67s. 6d to 70s. per ton.

Tinplates.

Only a moderate amount of business is passing just now in the tinplate market, but with a better volume in inquiries in circulation some improvement is shortly anticipated. Prompt plates are mostly in demand, and for these 19s. 9d. to 20s. has been offered. Transactions on forward account were reported at 19s. 6d., and there is quite a lot of business ready to be placed at a limit of 19s. 3d., but makers are firm and not disposed to accept this figure.

Metals.

Copper.—Movements in the standard copper market during the past week have shown a somewhat easier tendency in values, mostly due to profit-taking on the part of operators, and partly also to impending developments in increased production in the States. The outlook, however, is regarded as favourable to future expansion of consumptive demand, consequent on resumed activity in the engineering departments, though whether this will counterbalance increased production of the metal is as yet quite an uncertain factor in the position. Exports of copper from the States during April are estimated at about 30,000 tons, making about 130,000 tons during the first four months of the year. Closing prices.—*Cash*: Wednesday, £61 7s. 6d.; Thursday, £61 17s. 6d.; Friday, £61 17s. 6d.; Monday, £62 5s.; Tuesday, £62 2s. 6d.; *Three months*: Wednesday, £61 12s. 6d.; Thursday, £62 2s. 6d.; Friday, £62 2s. 6d.; Monday, £62 10s.; Tuesday, £62 10s.

Tin.—Transactions in the standard tin market at present are on a fairly substantial basis as far as buying is concerned, but values, on the other hand, have a fluctuating tendency, influenced, it is assumed, by the statistical position showing heavy stocks of metal held by Eastern interests. This policy represents a large amount of capital locked up which must ultimately be realised at a considerable loss to the Federated Malay States Government. In America, also, values of tin have receded, but the demand is reported as satisfactory. The automobile and tinplate industries appear to be working at practically full capacity, and in the States the general feeling that prevails is one of optimism. A little business has been done with China; meanwhile a limited trade only has been done with the Continent. Closing prices.—*Cash*: Wednesday, £150 10s.; Thursday, £151 5s.; Friday, £152 10s.; Monday, £152 12s. 6d.; Tuesday, £152 7s. 6d. *Three months*: Wednesday, £151 15s.; Thursday, £152 5s.; Friday, £153 10s.; Monday, £153 15s.; Tuesday, £153 7s. 6d.

Spelter.—Consumption of this metal continues on a satisfactory scale, and values are firmly held. At the moment offerings from European producers are light, while American smelters are not yet operating to normal extent. Uncertainty as regards future supplies has influenced some stiffening of prices. Closing prices.—*Ordinary brands*: Wednesday, £27 15s.; Thursday, £27 15s.; Friday, £27 17s. 6d.; Monday, £28; Tuesday, £27 17s. 6d.

Lead.—The market for soft foreign pig maintains its recent firmness, labour difficulties in Spain holding up increased supplies. *English* lead is in fair demand, and steady at the following closing prices:—Wednesday, £26; Thursday, £26; Friday, £26; Monday, £26; Tuesday, £26.